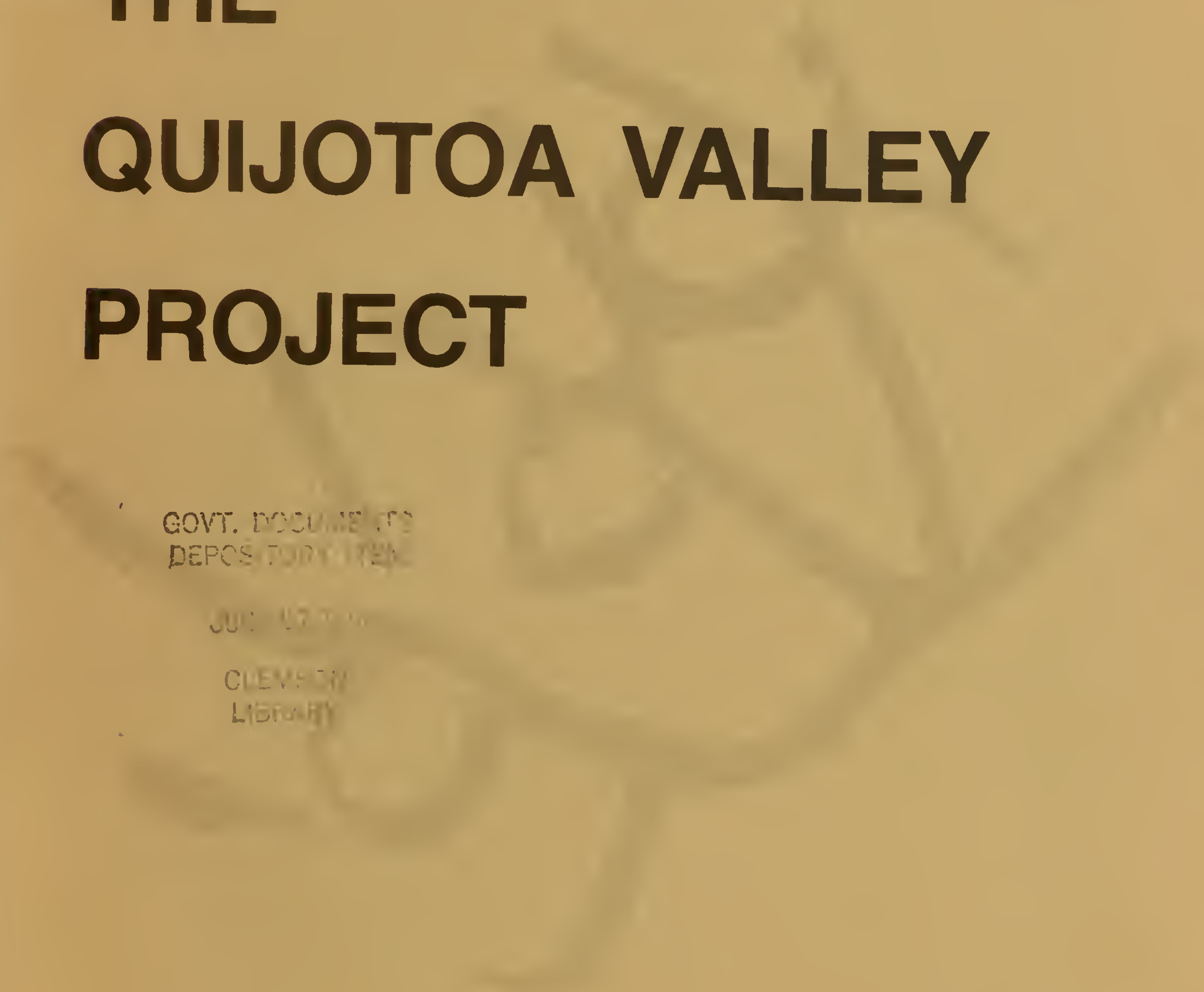
THE QUIJOTOA VALLEY PROJECT



U.S. Department of the Interior / National Park Service

THE QUIJOTOA VALLEY PROJECT

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Tucson, Arizona
1978

Figure 1. Papago Indian Road Route 1, a southward view toward the Gu Vo Hills.

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ACKNOWLEDGEMENTS

This report on the Papago Indian Road's Quijotoa Valley Project was possible because of the cooperation and support of our colleagues at the Western Archeological Center and the University of Arizona.

First, the initiation of the Project by Garland Gordon and its continuation under John Clonts relieved the field and laboratory staff of much administrative work and allowed for uninterrupted research over a four year period. Additionally many individuals at the Western Archeological Center provided assistance and comments on the full report. We are indebted to Judy Reis, librarian; George Teague and Lynette Shenk, archeologists, and Dr. Dennis Fenn, soil scientist.

Conversations and consultations with individuals at the University of Arizona aided our analysis. Dr. E. W. Haury was always available to clarify points and discuss problems. Dr. Bernard Fontana and Dr. C. Vance Haynes also commented on historical and chronologic problems, respectively, and their ideas proved most useful. The staffs of the Department of Invertebrate Biology, Geosciences and Anthropology eagerly assisted research and answered questions; likewise the Arizona State Museum opened its facilities to our use.

Special thanks go also to Julian D. Hayden and V. K. Pheriba Stacy who provided information on the nature of archeological remains on the Papago Indian Reservation.

Finally we wish to extend our gratitude to the clerical and administrative staff at the Western Archeological Center; Carla Martin, Chief; Frankie Barber, Procurement Clerk; Doris Russell, Secretary, Division of External Programs; Marie Fraser and our manuscript typist, Mary Jo Mills. Special thanks go to our editors, Barbara Sims and Paulette M. Coulter.

Too often a theory is promptly born and evidence hunted up to fit in afterward. Laudable as the effort at explanation is in its proper place, it is an almost certain source of confusion and error when it runs before a serious inquiry into the phenomena itself. A strenuous endeavor to find out precisely what the phenomena really is should take the lead

(Chamberlain 1973:396).

INTRODUCTION

By

E. Jane Rosenthal

Since 1973, the Western Archeological Center of the National Park Service (NPS) has been surveying, evaluating and excavating sites along new roadways on the Papago Indian Reservation, south-central Arizona. This archeological work was done at the request of the Bureau of Indian Affairs, Phoenix Area Office, Branch of Roads. The initial portion of the Papago Roads Project has been described by Stacy (1975). This report discusses the archeological work undertaken specifically along Papago Indian Road No. 1 (P.I.R. 1) and at a single site along Road No. 34 (P.I.R. 34) in the Quijotoa Valley, the western periphery of the Reservation.

Survey of the right-of-way began on September 2, 1973, and continued through December of the same year. Excavations near Hickiwan Village (P.I.R. 34) were conducted from February 21 to April 15, 1974. On April 16, 1974, testing began along Route 1. In September 1974, a final program of site excavation at loci that could not be avoided by the proposed road was initiated. This fieldwork was completed March 31, 1975. Laboratory activities began in March of 1974 and continued until September 1976, with a predominately part-time staff. Technical studies of pollen and bone and radiometric dating were accomplished from June of 1975 to June of 1976. (See Appendices.)

The Project Director and initial Field Supervisor was John B. Clonts. In the spring of 1974, Douglas R. Brown became Field Supervisor and Bruce Jones became Laboratory Supervisor. In April 1974, Michael R. Waters joined the staff as a laboratory aide, while the Papago crew of Leroy Miguel, Maynard Antone and Melvin Francisco conducted the excavation activities. In August of 1974, E. Jane Rosenthal succeeded Jones as Laboratory Supervisor. In the spring of 1975, Marc B. Severson became the ceramic specialist and Roberta Hagaman initiated statistical studies for the Project. In the final months of field work, Larry Patricio and Roger Ramon joined the field crew.

Special studies were completed by Richard S. White (Faunal Remains), Jeff H. Shipman (Human Remains), Wallace B. Woolfenden (Pollen Analysis), Larry Arnold (Radiocarbon), Harold Krueger (Radiocarbon) and Jay Severa (Petrology). William Doelle took paleomagnetic samples which were processed by Robert L. DuBois. Artifact photographs were the work of Joanne Ellison, and maps and illustrations were prepared jointly by Charles Steenberg and Marc Severson. The cover was illustrated by Brigid Sullivan.

THE ENVIRONMENT OF THE NORTH CENTRAL PAPAGUERIA

The Sonoran Desert, which extends across southern Arizona and California, Baja California and northern Sonora, has a diverse ecosystem. Our study area, the Quijotoa Valley, is a small portion of this arid landscape.

Common desert features — low humidity, paucity of rainfall and high evaporation to precipitation ratio — characterize the Quijotoa Valley. The Sonoran is somewhat wetter than most deserts, receiving more than 22.86 cm (9 inches) average rainfall annually in the study area. This precipitation occurs during two seasons; in the late winter to early spring, frontal storms moving east off the Pacific drop steady moisture, and in the summer localized convectional thundershowers occur. Fifty-five percent of the rain falls between the months of July and September (Sellers and Hill 1974: 354, 392). Because of this rainfall regime and associated extremes of temperature, specialized biota have evolved (Edney 1960; Schmidt-Nielsen 1964).

For the last 40 years Quijotoa Valley temperatures have been recorded at Pisinimo Village. During July and August the average daily temperature is in the upper 80's with maxima of 110-115 degrees. Winter daytime readings are consistently in the upper 60's (Sellers and Hill 1974: 393). These warm winter months produce a growing season of 331 days in nearby Ajo.

The Quijotoa Valley is a wide basin bounded by several rugged hills. The eastern border is formed by the range from which the valley takes its name. The Quijotoa Mountains rise to a peak of 1,225 m (4,013 ft) just

northeast of the study area. On the west, the abrupt topographic divide of the Ajo range delineates the valley's periphery, with Mt. Ajo and Montezuma's Head rising to 1,465 m (4,808 ft) and 1,107 m (3,634 ft), respectively. The valley floor lies approximately 610 m (2,000 ft) above sea level, some 122 m (400 ft) higher than the plains to its west (U.S. Geological Survey 1975: Map of Arizona 1:500,000).

Within the Quijotoa Valley are several smaller ranges which penetrate the heavy sediments of the basin. At the northern extreme of the study area, near Hickiwan, lies Cimarron Peak and its surrounding hills. Toward the south, outliers of the Ajo Mountains include the Gunsight Hills, the Gu Vo Hills, the Mesquite Mountains and the Cerritas de la Angostura. Three minor valleys are also found in the southern portion: Pia Oik, Ali Chuk and Quitani. The Barajita Valley is between the Ajos and the southern Gu Vo Hills (Bryan 1925).

Abrupt north-to-south trending ranges separate wide alluvial basins in the Papaguerian section of Arizona's Basin and Range Physiographic Province. Here mountain building and degrading have been occurring for a long time. Early and middle Tertiary rocks of andesitic composition are the primary constituents of the ranges and underlie the area. They are often covered by basaltic andesites and basalt. These tilted and faulted blocks reflect Recent and Quaternary events and are the prominent physiographic features of the study area.

The alluvium of the valley floor is formed from material that has been transported and sorted by flowing washes. Derived from the ranges, their grade varies from gravels and sands of pediment locales to sandy, clayey silts on valley floors and along arroyos. These soils are well aerated and are high in carbonates, sulfates and magnesium and sodium salts. The coarser bajada soils retain water better than the finer valley sediments and therefore support a more diverse vegetation. In contrast, caliche hardpan, which develops in poorly drained areas, often retards vegetation and proper soil drainage.

Surface water is scarce and variable in location. There are no perennial streams. Seeps and springs exist primarily in the Quijotoa and Ajo

Mountains. Rock tanks or "tinajas" are distributed along washes and within volcanic outcrops where scour pools have been worn in the rock. Such catch-pools collect surface runoff and often retain water for several weeks. On occasion, water can also be found in washes below the sandy surface or trapped in adobe flats where clayey soils provide a seal against percolation. Such "charcos" are often improved upon by channeling and diking, but water evaporates rapidly from these adobe flats.

Flora

The vegetation distribution of the Sonoran Desert depends upon climate, soil, topography, drainage and water availability. Three of the seven vegetal subdivisions of the Sonoran Desert can be found in the north-central Papagueria: the Arizona Upland (Succulent); the Lower Colorado (California Microphyll); and the northern extension of the Plains of Sonora on the Mexican Gulf Coast (Fig. 2) (Shreve and Wiggins 1964).

The Plains of Sonora plants reach their northernmost extension in the Organ Pipe Cactus National Monument and the Quijotoa Valley. Typical plants include the organpipe (*Lemaireocereus*) and senita cactus (*Cereus schottii*) and the elephant tree (*Bursera*) (Benson 1969: 207; Kearney and Peebles 1969: photos 25 and 27).

The Lower Colorado valley subdivision is found on the basin's lower-lying areas. Because these locations receive less effective moisture, the vegetation is primarily low, open stands of mixed creosote (*Larrea*) and bursage (*Franseria*). Extending from the bajadas up to the lower flanks of the mountains are the vegetal associations of the Arizona Upland subdivision. This community contains a wider variety of species than the Lower Colorado sections. In most low-lying areas creosotebush still predominates, but elsewhere desert trees and cacti are common. The conspicuous member of the Arizona Upland is the saguaro-paloverde association.

Most of the Quijotoa Valley may be placed in the Arizona Upland subdivision. Four principal biotic communities, designated by their floral associations, are found in the study area. These are the creosotebush-

bursage, the saguaro-paloverde, the desert riparian and the "relic" oak-juniper communities.

The creosotebush-bursage association is composed primarily of shrubs and dwarf shrubs (Lowe 1964b: 27). It blankets large portions of the alluvial basins and finer-soiled lower bajadas where the topography is flat. Common species in this association include creosotebush, white bursage, occasional white thorn (Acacia constricta) and southern intrusives like elephant tree and Jatropha cuneata (Hastings and Turner 1965: 188). Where soil is rockier, this vegetation integrates with plants of the paloverde-saguaro association.

Well-drained slopes and hills throughout the Quijotoa Valley support developed stands of the green-barked paloverde and the giant saguaro cactus. Along with these prominent representatives several shrubs are prevalent. They include triangle bursage, brittlebush (Encelia farinosa), wolfberry (Lycium), "pygmy" cedar (Juniperus communis) and Jatropha. Non-riparian distributions of desert trees like ironwood (Olneya), cholla (Opuntia spp.), mesquite (Prosopis), senita, organpipe, night-blooming cereus (Peniocereus) and elephant tree are found. Smaller cacti abound; pin-cushion (Mammillaria), barrel (Ferocactus) and prickly pear (Opuntia spp.) are most common. Riparian communities are distributed along washes in both the Lower Colorado and Arizona Upland subdivisions. Members of this association include the blue (in contrast to the foothill) paloverde (Cercidium floridum), mesquite, ironwood, smoke tree (Dalea spinosa), cottonwood (Populus fremontii), arrow weed (Pluchea sericea), catclaw (Acacia greggii) and crucifixion-thorn (Holacantha emoryi).

The peripheral range of the Ajo Mountains sustains a fourth regional association that was readily accessible to aboriginal exploitation, the oak-juniper woodland. This vegetation is currently restricted to the heads of canyons above 1,219 m (4,000 ft) (U.S. Department of the Interior: 1976: 56). At this altitude annual precipitation approaches 38 cm (15 inches) and a more mesic growth can be supported. Two types of juniper (One-seed and Utah) and Ajo oak (Quercus spp.) are found along with some jojoba (Simmondsia) and manzanita (Arctostaphylos).

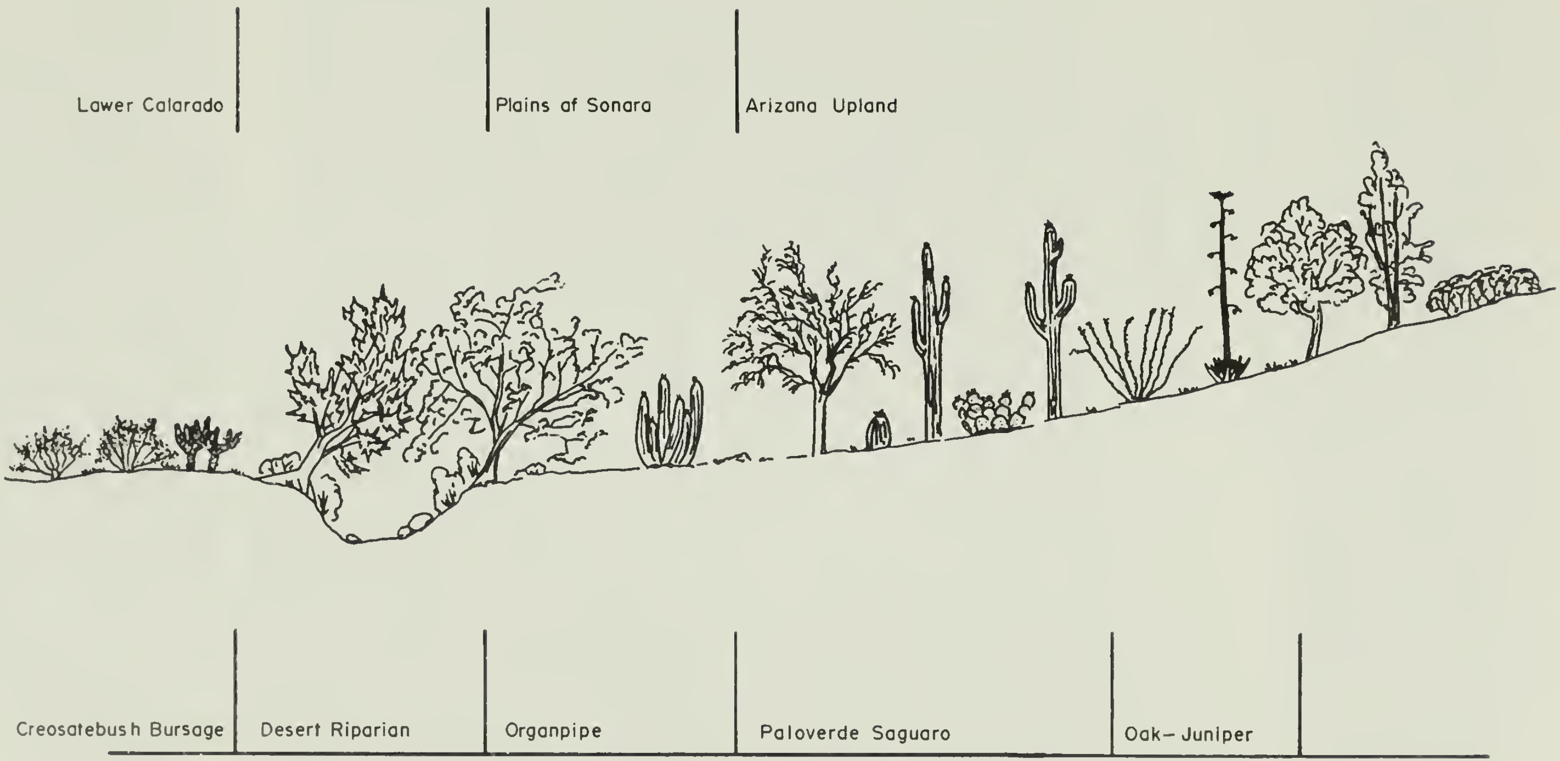


Figure 2. Vegetational zones.

The above associations produce a great floral diversity in the Quijotoa region; however, it should be emphasized that most of the Project area is covered by creosotebush and bursage. Other communities were nonetheless easily accessible and probably were more extensive prior to the 19th century (Hastings and Turner 1965).

Fauna

Due to overgrazing, hunting and expanding local population, the fauna of the Quijotoa Valley is not as varied as might be expected given the diverse flora. Nearby in the Organ Pipe Cactus National Monument there exists a protected animal population that somewhat reflects the aboriginal situation (U.S. Department of the Interior 1976).

Small mammals abound. Pocket (*Perognathus* spp.) and cactus (*Peromyscus eremicus*) mice, packrats (*Neotoma* spp.), kangaroo rats (*Dipodomys* spp.), squirrels (*Citellus* spp.), cottontail rabbits (*Sylvilagus audubonii*) and hares (*Lepus alleni*, *L. californicus*), bobcats (*Lynx*), badgers (*Taxidea taxus*) and coyotes (*Canis latrans*) are all common (Cockrum 1964). Large mammals throughout the region are endangered species and are relatively rare. Nevertheless, white-tailed deer (*Odocoileus virginianus*), desert pronghorn antelope (*Antilocapra americana*) and desert big-horn sheep (*Ovis canadensis*) still survive. The deer and sheep reside in the rocky masses of the Ajo range, while the antelope travel across the plains in the western section of Organ Pipe Cactus National Monument. Bajada areas also have small groups of collared peccary or javelina (*Pecari tajacu*) (Cockrum 1964: 258). This animal, however, is unrecorded archeologically and may be a recent immigrant from the south.

A varied avian and herpetologic fauna is abundant in the study area. Birds include falcons (*Falco* spp.), buzzards (*Cathartes* spp.), hawks (*Buteo*), eagles (*Aquila*), elf owls (*Glaucidium brasilianum*), thrashers (*Mimidae* spp.), flickers (*Tonostoma curvirostre*), woodpeckers (*Colantes*), quails (*Dendrocopos*) and doves (*Zenaida* sp.) (Monson and Phillips 1964). Numerous species of reptiles are found in the Quijotoa Valley and in

Organ Pipe Cactus National Monument. The Sonoran mud turtle (Kinosternon sonoriense), desert tortoise (Gopherus agassizi) and gila monster (Heloderma suspectum) are often sighted, as are numerous snakes, like Sonoran coral (Micruroides euryxanthus), rosy boas (Lichanura trivirgata) and Why (local name). Six species of rattlesnake are known locally, as are several kinds of iguanids and lizards (Lowe 1964a).

Environmental Change

Paleo-Indian occupation of the Papagueria begins in the late Pleistocene (Haury 1950:527). The changes in the Sonoran Desert since that time form part of the picture of aboriginal lifeways in the area. A reconstruction of the past climate and environment was proposed by Bryan in 1950 (Haury 1950: 126). He noted the presence of a geologic disconformity at Ventana Cave and suggested a warmer, drier period dating roughly from 8,000 to 3,500 years B.C.

Recent analyses of packrat middens in the Lake Mohave region and in southern Arizona's New Water and Ajo Mountains complement Bryan's early ideas. Van Devender's work (1976) indicates that life zones extended to altitudes 260 m to 660 m lower during the terminal Pleistocene. Mehringer (Mehringer and Warren 1976) has postulated an even greater 1,000 m depression for the Amargosa desert. A reasonable application of these data could mean that most bajada areas of the north-central and eastern Papagueria (to about 792 m or 2,600 ft) were previously covered with juniper or mixed pinyon-juniper associations. Van Devender (1976:5-6) has concluded, "woodlands persisted until at least 8,000 years ago in the Southwestern deserts."

King (1976) has studied several Holocene packrat nests from the Lucerne region of Lake Mohave. His findings indicate a second expansion of woodlands in the medi-thermal after the drier post-Pleistocene altithermal (1976:personal communication). Both Van Devender's (1976) and King's (1976) research contradict Martin's statement (1963: 70) that "under a climate similar to the present and with existing biotic zones in

place, the early hunters (paleo-Indian) were obliged to begin the 7,000 year experiment with native plants — leading . . . to the domestication of certain weedy camp followers."

It is not possible to assume the unvaried environmental continuity suggested by Martin. Life zone shifts during periods of lower temperature and higher rainfall must be considered for the north-central Papagueria. During paleo-Indian and Amargosan times, the expansion of juniper and of paloverde-saguaro associations may have presented a markedly different environment than appears in the region today.

HISTORICAL SUMMARY

Coronado and Fray Marcos de Niza were the first Europeans to view Arizona's landscape. In 1540, they skirted the Papagueria as they journeyed northward along the San Pedro River searching for the fabled "Cibola." Shortly thereafter, Melchior Diaz entered the Papagueria on his passage to the Colorado River. Accidentally impaling himself on a lance, he sickened, died and was buried on January 18, 1541, perhaps near the Sierra Pinacate. (Hammond and Rey 1940: 21).

For 150 years the Spanish colonizers ignored northern Sonora. Then in 1692, Father Eusebio Francisco Kino, S.J., traveled into the region and established a series of missions. In June of 1694, Kino and his military companion, Juan Matheo Mange, left Mission San Dolores to proselytize among the desert Indians north of the Altar Valley. During this tour, Mange proceeded from Busanic toward the northeast and, on the afternoon of June 9, wrote (1926: 230):

> llegamos a una rañchería que llaman el Gubo, cuyos indios gentiles nos salieron a recibir trecho del camino, por haber los del Tucubavia adelantado el aviso, son indios desnudos estos, aungue amigables, y no dejaban de tener maiz y milpas sembradas de temporal y de tierras, y dehesas fertiles y aspastadas; conté 90 personas, aunque solo tienen un corto manatial en que beben, que corre hacia un

> tanque immediato de agua verdosa donde se sume, cuyo color será por la represa que en el hace . . . nos despidimos y proseguimos al Norte por los llanos secos y esteriles.

Karns (1954: 41) translates Mange's description as follows:

> We came to a settlement called Gubo where heathen Indians came out to the road to meet us. The Indians, though naked, were friendly. They had cornfields planted in fertile soil and good pasture lands. I counted 90 of them. They secure drinking water from a small spring which flows into a pool nearby. The color of the water is green, and at this pool it submerges. The greenish color must be because of stagnation . . . we continued north over dry and sterile plains.

This passage is the first written description of the Quijotoa Valley and particularly of Gubo, a small rancheria in the south-central section. Perhaps the village was not far east of modern Gu Vo. Mange and Kino revisited Gubo in April of 1701, and Mange (1926: 291) again reported many people living near their growing fields. After Kino's death his successors did not travel extensively or report on the Quijotoa Valley.

In 1751 the Jesuits tried to establish a mission nearby at Sonoita; however, the Piman rebellion of the same year ended this attempt at missionizing (Bolton 1930: 85). When Charles III expelled the Jesuits from New Spain in 1767, Franciscan friars subsequently took over their mission chain in Sonora. By the 1770's they had turned from an interest in the Pimeria Alta to proselytizing among Yuman tribes along the Colorado. In 1771, Fray Francisco Garces visited Sonoita but concentrated his efforts further west. The Mexican colonizer of California, Juan Baptista de Anza, also briefly passed through the southern and western Papagueria in 1774 (Bolton 1930: 78).

By the early 1800's Apache raiding had forced a consolidation of Papago villages. The transfer of control from Spain to Mexico after the 1820 Revolution did not alleviate this pressure; in fact, the Apaches renewed their attacks (Dobyns 1972: 33).

In the 1850's the Anglo period of Papagueria history begins. With the Gadsden Purchase of 1853, several border surveys were initiated. Lieutenant Michler of Major Emory's border survey, traveling the periphery of the present Reservation in 1856, reported on its topography and people. He described the valleys west of the Baboquivari Mountains:

> This plain is nearly level, and covered with low mezquite, and a few withered plants; its white surface, perfectly destitute of grass or of any verdure, gives it a dismal appearance. There is no water except in charcos, or ponds, filled by drainage after heavy rains (Emory 1857: 233).

Anglo mining activities also began during the 1850's. The first mines were opened near Ajo but were rapidly followed by others in the Gunsight Hills and the Ajo Mountains.

In the late 1890's, W. McGee was sent by the newly established Bureau of Ethnology to survey in Sonora. He spent much of 1894 in the Papago country, but his final report concentrated on the Seri Indians (McGee 1898: 12). Carl Lumholtz, in contrast, traveled widely in the Papagueria. His vivid writing in the New Trails to Mexico (1912) describes numerous Papago rancherias, but he apparently did not visit the Quijotoa Valley.

The U.S. Government began apportionment of parts of the Papagueria as a reservation in 1911. By 1916, the Quijotoa Valley had become part of the Papago (Sells Agency) Reservation. In the 1920's, the U.S. Geographical Survey sent Kirk Bryan on a hydrologic reconnaissance. He recorded several watering places in our study area and mentioned the village of Gubo, its lava hills and the Quijotoa Valley:

> one of the largest areas of plains in the Papago country being roughly 20 miles in diameter. . . . The summer rancheria of Gubo was in 1917, without permanent water. . .. A deep well drilled into the underlying lavas here should be successful (1925: 237, 241).

In the 1930's, the U.S. Government acted upon Bryan's advice. With an all-Indian Civil Conservation Corps, several wells were drilled in the Quijotoa Valley, thereby fixing the settlements in permanent locations (Dobyns 1972: 54).

Today, the southern and central portions of the Quijotoa Valley have several major villages representing two tribal districts and two distinct Papago dialects. In the Gigimai dialect district prominent settlements include Hikiwani (Hickiwan) and Ve Wo'o (Gu Vo). In the Huhuwosh district are found S-i'owi Shuhdagi (Siovi Shuatak), Pi O'oik (Pia Oik), Al Aki Chini (Ali Ak Chin) and Al Jeg (Ali Chuk) (Saxton and Saxton 1969).

PREVIOUS ARCHEOLOGICAL WORK

Archeological investigations in the Papagueria began in 1929 when a reconnaissance survey was conducted by Gila Pueblo. Six quadrants of Arizona and Sonora were visited, including two within the Quijotoa Valley. In discussing the research, Gladwin and Gladwin reported that most remains dated from the 12th century (Classic) to the present (Historic) times and stated (1929b:129), "prehistoric sites were found in close proximity to sandy washes where gardening might be carried out."

A hiatus of ten years followed the Gila Pueblo work. Then, in 1939, the Arizona State Museum began a four-year fieldwork campaign designed to answer questions about Papago history and prehistory (Haury 1950: 5). At Jackrabbit Ruin, seven miles east of Sells, Scantling (1939) initiated investigations. Under his direction an extensive single-phase village with several large trash mounds was excavated. This work at Jackrabbit Ruin defined the final prehistoric period in the Papagueria, the Sells phase.

Later in 1939, a second Museum project was begun at Valshni Village, some fourteen miles southwest of Sells (Withers 1944). Valshni was a stratified site with a walled enclosure, several houses and five large trash mounds. Through ceramic and architectural analyses, Withers (1944:9) identified three relative chronological phases for the Papagueria: the Vamori phase, A.D. 800-1100; the Topawa phase, A.D. 1100-1250; and the Sells phase, A.D. 1250-1400.

In 1940, the Museum staff turned their attention to a large rock overhang in the Castle Mountains, Ventana Cave, one of the Southwest's most

important sites (Haury 1950). Excavations were conducted during two field seasons. From these Haury documented over 13,000 years of Papaguerian occupation and established a regional preceramic chronology. Concurrent with the Ventana work, Field Director Hayden (n.d.) observed the testing at Ash Hill, a Sells phase site southeast of the cave.

Between 1941 and 1972, Papaguerian archeological research was confined to surveys, of which three projects in the Organ Pipe - Gran Desierto section are noteworthy. In 1951, Ezell (1954) surveyed the Organ Pipe Cactus National Monument, locating 72 sites primarily on the pediments of the Ajo, Puerto Blanco and Growler ranges (U.S. Department of the Interior 1976). Ezell recognized the region's distinctiveness and separated sites by their ceramic components. His data presented a cultural boundary for the Papagueria's "Sonoran Brownware Tradition" (Ezell 1955: 369).

Hayden, following Ezell's (1955) and Malcolm Roger's (1958) footsteps, inaugurated an intensive survey of the Sierra Pinacate lava fields in northwestern Sonora. By 1975, his research in this 600-square mile area had located 72 sites dating from paleo-Indian to historic Sand Papago times (Hayden 1976). Hayden's recent analysis stressed the dense preceramic occupation of the Papagueria and refined the chronology for paleo-Indian and desert Archaic periods (Haury and Hayden 1975).

Between Organ Pipe Cactus National Monument and the Sierra Pinacate lies the Cabeza Prieta Game Range, briefly surveyed by Fontana in 1962 (1965). He located 20 sites, many of which were surface "camps." Although of limited scope, the Project did confirm the presence of preceramic and Yuman (Sand Papago) material in the area.

Since 1972, much research has been conducted northeast of the Quijotoa valley in the Kohatk district's Santa Rosa Wash drainage system. Three major projects were carried out, focusing on functional distinctions among artifact sets at sites in varying environmental zones. These included the Santa Rosa Wash Project (Stacy and Palm 1970; Canouts and others 1972; Raab 1974) the Vekol Mine Project (Stewart and Teague 1974) and the Hecla Project (Goodyear 1975).

In 1973, the Bureau of Indian Affairs began a series of road building projects requiring archeological research. Stacy (1975) conducted initial surveys of valley floor areas before this construction. Her doctoral research on hilltop sites throughout the Baboquivari Valley complemented the Project. It focused attention on specialized activities, in particular, topographic situations, and laid the foundation for the continuing investigations along the roadways discussed in this report.

ETHNOGRAPHIC CONSIDERATIONS

Piman Indians have been the primary aboriginal group residing in southern Arizona since the time of Spanish contact. Although many dialects are found within this linguistic group, the major ethnic distinction is economic. The Pima traditionally lived along the lower Santa Cruz and Gila Rivers and practiced irrigation agriculture. In contrast, the Papago mountain-desert dwellers lived both south and west of the Pimas.

Papago people have maintained a series of semipermanent villages in the Quijotoa Valley throughout recorded history. Along the major washes several rancherias exist. These were, until recently, complemented by villages in mountain or foothill locales. Ethnographic research explains that this settlement pattern resulted from seasonal water needs.

The Papago subsistence system enabled these small semipermanent villages to be inhabited by patrilineally related families who practiced floodwater farming, hunted, and gathered wild foodstuffs to sustain themselves. As reconstructed by Castetter and Underhill (1935:4-9), the seasonal round proceeded in a set manner. The Papago year began when families left their mountain villages to collect saguaro fruit in foothill areas. By the time of the July rains, much of the wild food had been collected. Then the people moved down to the valley floor where, beside washes, larger "field" villages existed on terraces adjacent to family fields. While crops were planted and grown, the women continued to forage for cactus and particularly mesquite. Catchment ponds were dug to provide domestic water, and occasionally washes were diverted to sustain "charcos" for watering cattle herds.

By late fall, the crops were ready for harvesting and water supplies had evaporated. The families then climbed back to the smaller "well" villages where they gathered foodstuffs and hunted deer until the spring rains provided a new lush growth. By May the potential of the mountain communities had been exhausted, and movement to cactus camps began again, repeating the pattern.

The Papagos subsisted primarily on wild plants and game. Chief among these staples were saguaro and organpipe cactus fruit, cholla buds and fruits, mesquite beans, seeds of ironwood and paloverde, certain greens and sand root. Animal protein came from deer, rabbit, hare, mountain sheep, rats, squirrels and larvae. Cultigens were primarily corn, tepary beans, squashes, melons and, occasionally, wheat (Castetter and Bell 1942:56-57).

Although it is difficult to determine if 19th century Papago subsistence practices were similar to precontact methods, certainly all these wild resources were exploited prehistorically (Appendix 1). Changing technologic features, like the introduction of European domesticates, new tools and government wells, have altered patterns of land use; therefore, direct analogy cannot be comfortably used to interpret archeological finds. Nevertheless, possible activities which could have occurred at the Quijotoa Valley sites may be suggested by noting similarities in local, exploitable vegetation, available animals and processing equipment. Comparisons of these ethnographic accounts are limited due to the relatively recent (1930's) recording of most of the Papago lifestyle and the lack of information on their late 18th and early 19th century practices.

CULTURAL HISTORY

Artifacts from sites in the Papagueria (Fig. 3) show stylistic affiliations with surrounding regions and also have unique features. This distinctness has caused archeologists to delineate a regional chronology which recognizes outside influences but emphasizes the Papagueria's own traditions.

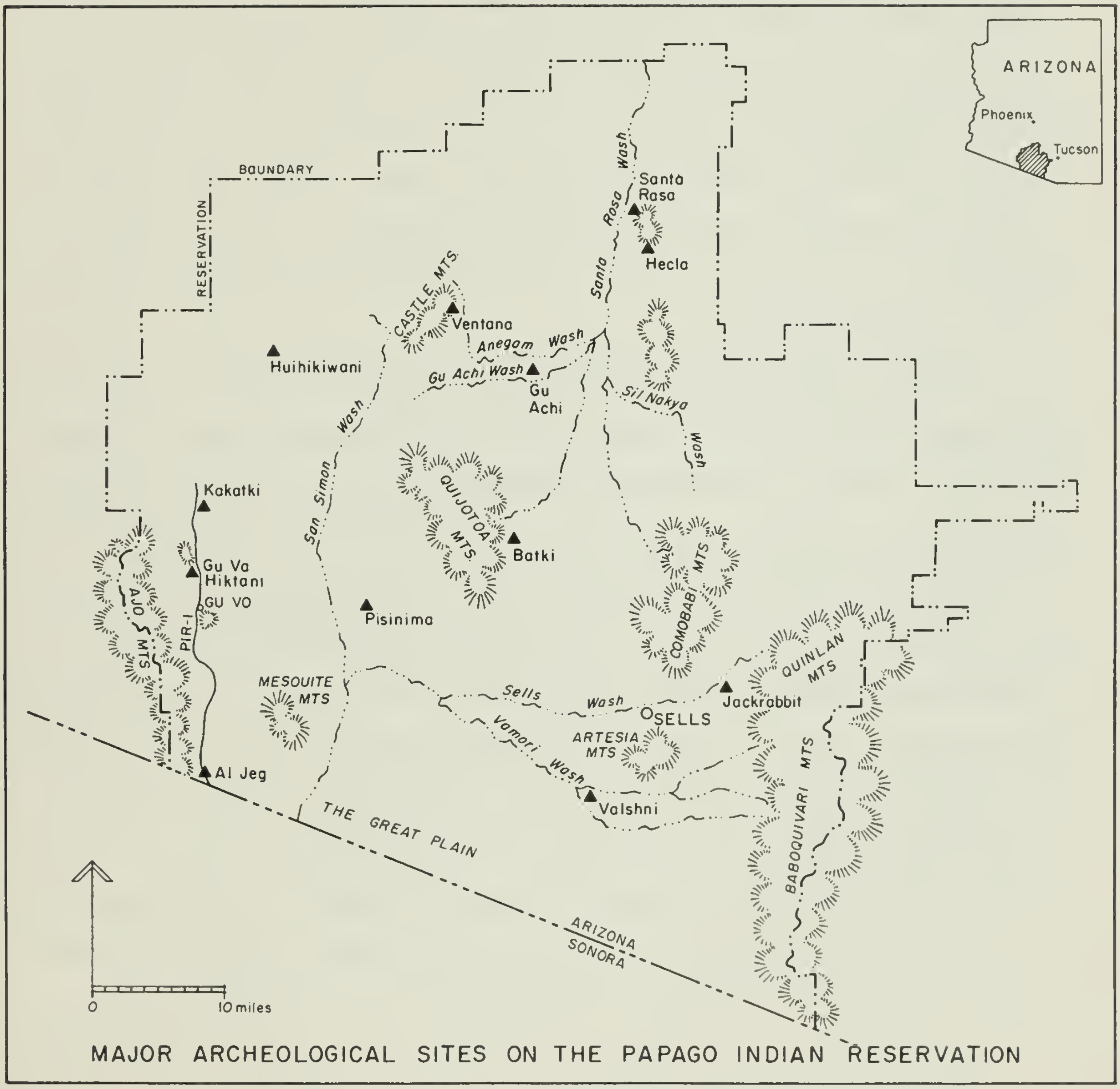


Figure 3. Major sites on the Papago Indian Reservation.

One of the earliest dated occupations of the American Southwest is Ventana Cave in the Papagueria. Here, amid the bones of extinct dire wolf, jaguar, shasta ground sloth and horse, a complex of almost 100 tools was recovered. A single concave-base point on a worked flake represents the Clovis (paleo-Indian) influence. A series of steep, retouched flakes and blocky, unifacially and bifacially reduced cobbles reveal the artifacts' affiliation with the western desert paleo-Indian. Haury (1950) termed this early material the Ventana Complex, belonging to the San Dieguito. Radiometric dates of San Dieguito from Ventana are 11,300 to 12,600 B.P. (Haury and Hayden 1975:v).

Further evidence for two phases of this early complex has been located by Hayden (1976) in the Sierra Pinacate Region. The Basal San Dieguito or "Malpais" phase consists primarily of heavily oxidized and varnished unifaces. The later San Dieguito I material is a more diverse industry, but both lack the elaborate bifaces, blades and burins of the paleo-Indian traditions in the Great Plains.

The early Holocene period occupation of the Papagueria is not well understood. Changing climatic or depositional conditions produced a stratigraphic hiatus at Ventana Cave (Haury 1950:530-43). When occupation was resumed, a decidedly different complex was used--the desert Archaic of the American West, with its smaller dart points and groundstone industry. The Post-Altithermal period (after the aforementioned hiatus) is represented archeologically at Ventana Cave by the Amargosa Complex, subdivided into two preceramic periods, Amargosa I (Haury's Ventana-Amargosa and Chiricahua-Amargosa) and Amargosa II (San Pedro) (Hayden 1976; Haury 1950). Hayden has also found numerous Amargosan sites in the Sierra Pinacate, Mexico.

The Amargosa complex is typified by shrines, sleeping circles and an elaboration of flaked tools. Although the remains from these periods contain projectile points identical to the Cochise Complex of southeastern Arizona, they also have Pinto, Silver Lake and Gypsum Points native to the California Desert. However, Haury (1950: 319-20) noted the absence of typical, contemporaneous Cochise grinding stones and handstones in the Papaguerian material.

Ceramics and village life apparently were late developments in the Papagueria despite their early presence in eastern Arizona and the Gila-Salt Basin. The earliest settlement with ceramics is Valshni Village, a stratified site in the southern Baboquivari Valley. It would appear that Valshni was first occupied sometime during the Hohokam Colonial period and continued to be a village into the Classic period. At Valshni three phases of occupation have been identified, based upon ceramics and architecture: the Vamori, the Topawa and the Sells phases (Withers 1941). These phase designations have been greatly expanded to form a chronology for the whole Papagueria (Haury 1950:6-15).

The Vamori phase has been documented only at Valshni Village. It is the least elaborate manifestation of a tradition of brownware ceramics and subsurface houses. Sometime during the late Sedentary period, a transition to the intermediate Topawa phase occurred, and redware ceramics made their first appearance in the Papagueria.

The final ceramic phase is the Sells. This phase is extensively represented by scattered small village sites and activity areas throughout the central and eastern Papagueria. The typical artifacts associated with this phase are two types of sherds (Tanque Verde Red-on-brown and Sells Redware) and pulley-shaped spindle whorls.

It must be stressed that with the exception of the San Dieguito (Ventana) complex, the chronologic periods are all relatively placed by cross-dating intrusive material. It is only in recent years that charcoal has been submitted to analysis; therefore, fixed dates are not available for most of the prehistoric period.

The following relative chronology will be used in this report. Alternative chronologies are presented in Table 1.

San Dieguito	9300 B.C.+
Amargosa I - II	4000 B.C. - A.D. 800
Vamori	A.D. 800 - 900
Topawa	A.D. 900 - 1100
Sells	A.D. 1100 - 1450
Proto-Historic	A.D. 1450 - 1700

Table 1

SUMMARY CHRONOLOGY

	MOHAVE DESERT (Hester 1973, King 1976)	SOUTHEAST ARIZONA (Whalen 1973)	VENTANA-PAPAGUERIA (Haury 1975: v-vi)	SIERRA PINACATE (Hayden 1967, 1976)
Paleo-Indian				
9000 B.C.+	Pre-projectile Point			
		Unknown	Ventana Complex (San Dieguito)	San Dieguito
9000 B.C.	San Dieguito	Clovis		
Archaic				
7000 B.C.				
	Lake Mohave			
5000 B.C				
	Pinto	Sulphur Springs	Ventana Amargosa	Amargosa I
3000 B.C.				
	Amargosa I	Chiricahua	Chiricahua Amargosa	
1500 B.C.				
		San Pedro	San Pedro	Amargosa II
Ceramic				
500 B.C.				
	Amargosa II	Mogollon		
A.D. 500				
	Yuma I		Desert Hohokam	
A.D. 700				
	Yuma II			
Spanish Contact (Historic)				
	Yuma III	Sobaipuri	Papago	Pinacateno

RESEARCH OBJECTIVES

The primary objective of the Papago Indian Roads Archeological Project was to locate and evaluate all cultural resources within the proposed right-of-ways. The Quijotoa Valley survey specifically concentrated on assessing the density of artifacts and their integrity. As little was known about the valley, even isolated features were judged to be capable of adding knowledge. Forty-two loci were identified and examined for their potential for producing information about Papagueria regional history and prehistory along P.I.R. 1. For those sites deemed significant, a data recovery plan was developed. To alleviate the road construction's adverse impact, collecting, testing or excavating at ten sites along P.I.R. 1 and one site along P.I.R. 34 was proposed. Research questions that structured field and laboratory activities were formulated from the anomalies noted by the field archeologist during the initial survey.

The investigations of the Project were restricted by time, by funding and by the Bureau of Indian Affairs confining archeological research to the immediate 100-foot road right-of-way. These limitations meant that the sampling strategy was predetermined, as were the nature and portion of the sites to be researched. Formulating an elaborate, structured research design in this case seemed inadvisable. Instead, a cautious approach to data recovery was selected in hopes of maximizing the amount of information collected. Research goals concentrated on two productive problem areas indicated by previous fieldwork in the Papagueria: arid land adaptation (Stewart and Teague 1974; Goodyear 1975) and regional cultural history (Haury 1950; Hayden 1970; Ezell 1955).

ARID LAND ADAPTATION

The major hypotheses of the mitigation phase of fieldwork were that site locations would reflect the use of local resources and that context and character of artifacts would indicate site functions. Therefore, semi-permanent habitation sites should be situated near major washes

(Stacy 1975), and limited activity areas should be related to particular topographic or biotic features (Stewart and Teague 1974).

To support our hypotheses, the following types of information had to be recovered: (1) evidence for structures, mounds and farming at washes; (2) a greater variation of artifacts at sites near washes; (3) specialized and simplified tool-kits away from washes at rock outcrops and tanks; (4) workable stone or other specific resources and (5) isolated finds of hunting or food-processing tools.

Although observations about a site's permanency and accessibility of local resources could be made in the field, much of the hypothesis testing relied on laboratory analysis of tools and ethnobiologic material. Data recovery procedures stressed the controlled collection of artifacts, the screening of all excavated materials, and the sampling of soils for archeological pollen. A final stage of the proposed analysis was to compare our new subsistence data with previous information on Pima and Papago resource use. This procedure would focus on continuity and change in desert exploitation through analogy.

CULTURAL HISTORY

The initial survey highlighted a second area requiring research to clarify problems. From the available literature, we could not identify the cultural affiliation or chronologic period represented by our material. The absence of Red-on-buff ceramics, redwares, recognizable tool types and standing structures presented analytic problems, as did the surface distribution of most of the resources.

A series of questions was posed about the regional culture history. What local traditions were present during paleo-Indian, Archaic and Ceramic times? What locales produce material from these periods? What was the nature of Riverine Hohokam influence in the Quijotoa Valley? Do Papagueria sites manifest the Desert Hohokam phenomena (Haury 1950)? What evidence might support Ezell's concept (1955) of the Sonoran Brownware Tradition? Is there a prehistoric to historic cultural transition

(Hayden 1970; DiPeso 1956)? Is there continuity in tool traditions from Archaic to Ceramic Times (Hayden 1967)?

To answer the above questions, a program of fieldwork had to be implemented to test all types of cultural resources. We proposed field activities at small scatters and features, as well as at major areas with subsurface material. In the field we attempted to identify and separate predominately aceramic areas and to note features like cairns and rock circles possibly attributable to Archaic and earlier groups.

Because history involves a great deal of careful descriptive work, comparative and replicative studies on all artifact categories were imperative. Laboratory analysis could also aid in determining the traditions of stone tool manufacture and pottery making.

The questions asked to orient our research were basic ones: who lived where, when, and how? We felt that the dearth of previous research in the valley required that this groundwork be completed before more specific processual problems could be investigated.

METHODS

By

Douglas R. Brown

Archeological work on Papago Indian Roads No. 1 and 34 was initiated in the fall of 1973. The three phases of field investigation included survey, testing and, if necessary, excavations. A crew of Papago men, previously employed as Archeological Aides by the Park Service on other reservation survey and excavation projects, was utilized in all phases of the P.I.R. 1 field research.

The 100-foot survey area extended 50 feet (about 15 m) to the left and to the right of a marked road centerline. The Papago crewmen preceded the archeologist to the right-of-way, marking the location of cultural resources with flagging tape and noting their impressions on a site survey form. At the end of the day, these forms were given to the archeologist, who revisited all the noted locations. After reviewing the crew's impressions and recording his own, the archeologist evaluated what mitigative work, if any, would be necessary. Not all locations were recommended for additional attention as the crew marked isolated finds and other areas of very limited resources as well as larger more intensive areas. Most of the sites recorded were sherd scatters, lithic scatters or sherd/lithic scatters. Four sites with features, but no sites with structures, were located within the right-of-way.

During the preliminary phase, based on the archeologist's evaluation, a number of sites were tested to determine cultural depth and intensity and whether subsurface features or structures were present. Surface material, surface configuration and feature locations were aids in determining test pit placement. Frequency of testing at any one site depended on its size and the intensity of its material. Usually at least two pits were placed at a site to check different areas and to gauge differences in the cultural associations beneath the surface. The first site test pits along P.I.R. 34 were 5 ft squares, and the remainder along P.I.R. 1 were gridded in 2 m squares. The crew dug the pits in 10 and 20 cm levels, screening

a. Gridding the right-of-way.
(M. Francisco, L. Miguel, M. Antone)

b. Excavating and screening.
(M. Francisco, L. Patricio)

c. Mapping a feature.
(L. Patricio)

Figure 4. Methods of fieldwork.

the fill through one-quarter inch hardware cloth. In most cases, the test units were dug down to a culturally sterile layer. Based on the results of the testing, programs for further excavations were either developed or considered unnecessary.

Certain basic methodological procedures were maintained during the next excavation phase. Uniform horizontal and vertical controls were established and adhered to in order to make both intra- and inter-site comparisons of material from corresponding areas and matrix volumes. The standard procedure was to establish an arbitrary 5 m grid system, using the road centerline as the north/south axis. Then a complete surface collection was done in the area to be affected by the construction. Areas of artifact concentration were sampled, as were some locales without abundant surface material. Length of collection areas varied from 30 to 390 m with a maximum width of 30 m, corresponding to the 100-foot right-of-way the contractors were using. Surface features were always sampled and often completely excavated (Fig. 4).

To maintain efficient horizontal controls over the site, sub-surface excavations were sampled in either 2 x 2 m units or 1 x 2 m units. The latter were usually joined end-to-end for a trench. The cultural material recovered in each unit helped determine the extent and pattern of subsurface investigations. A vertical control of 10 cm was maintained, which would have been forsaken for natural stratigraphy if such had been encountered. This arbitrary control was utilized so that material distribution could be plotted and reconstructed vertically as well as horizontally.

All possible tools and debitage pieces were collected and bagged, as were all sherds that did not pass through the mesh. Miscellaneous materials (shell, bone, metal and glass) were also collected. Counts of all material recovered were made in the field in order to suggest the total number of artifacts prior to analysis. Strict recording procedures for the collected materials were maintained throughout the field operation.

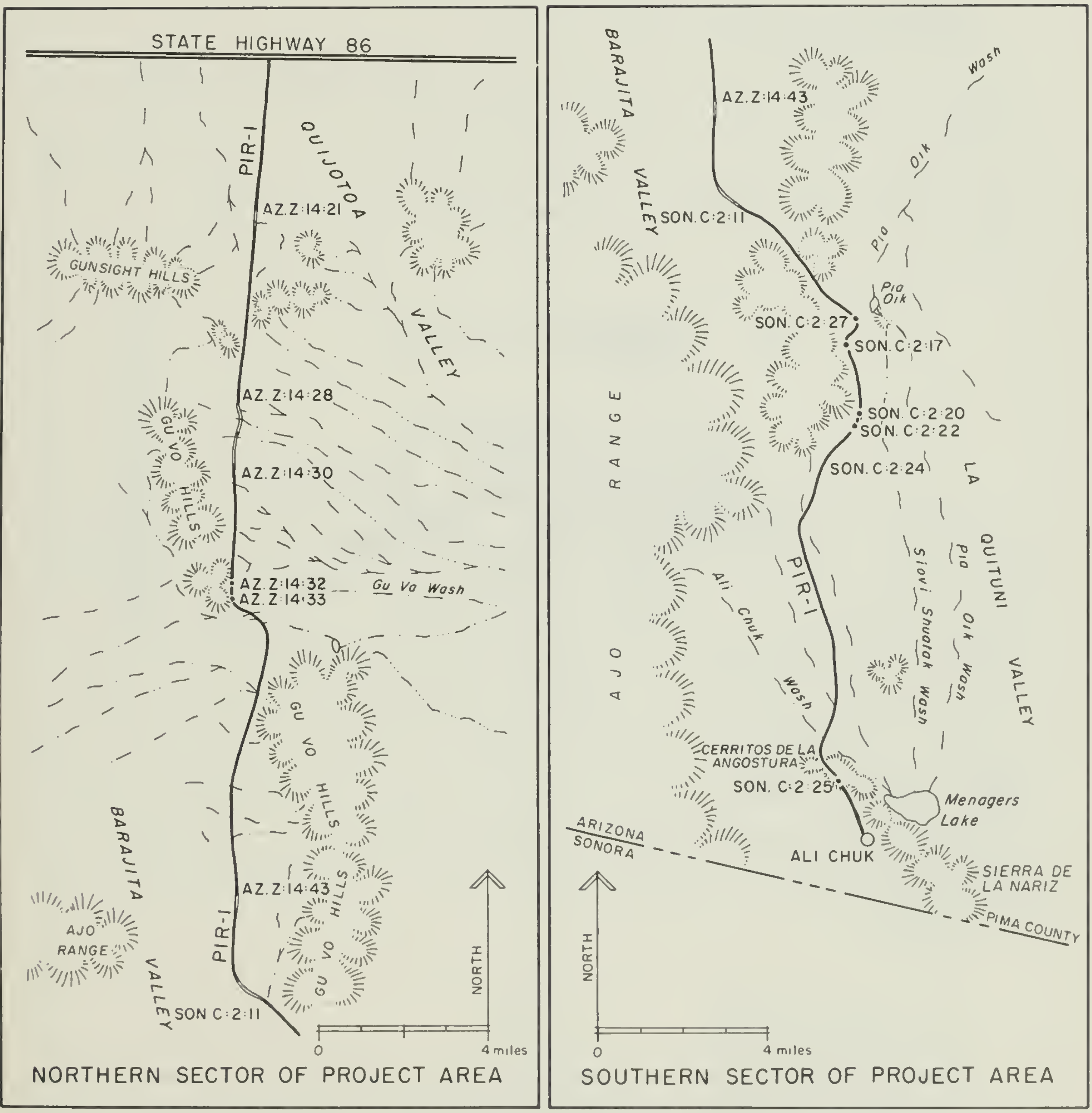


Figure 5. Map of northern and southern sectors of the Project area.

THE QUIJOTOA VALLEY SITES

By

Douglas R. Brown

During the initial survey and site location phase of fieldwork, 41 loci were documented and assigned Arizona State Museum site numbers (Table 2). Evaluation of material from these loci determined that eleven of the sites warranted further investigation (Fig. 5). Detailed descriptions of the sites and field methods employed at each follow.

HUIHIKIWANI, Az.Z:11:5

Setting

Arizona Z:11:5 (Fig. 6) is located 1.6 km (0.9 mi) east of the present village of Hickiwan along Papago Indian Road No. 34. The site is at an elevation of 670 m (2,200 ft) in the Hickiwan Valley, one-half mile north of Hickiwan Peak. The land is flat with a gentle slope to the southwest. Hickiwan Wash is bounded by small feeder drainages on the east and west. The soil is a light tan alluvium with scattered gravel deposits. Small rodent mounds are common and may have disturbed the cultural deposits. Ground cover in the site area is mainly creosote, with bursage second in predominance. Mesquite, paloverde, and cholla are common, especially near washes and in the low area between Hickiwan Peak and the site.

Site

The designated site area was 200 ft long, within the right-of-way, to the south of the road. A little material was noted north of the road but not enough to test or collect. No surface features were located either in or around the right-of-way. Surface material was mainly ceramic,

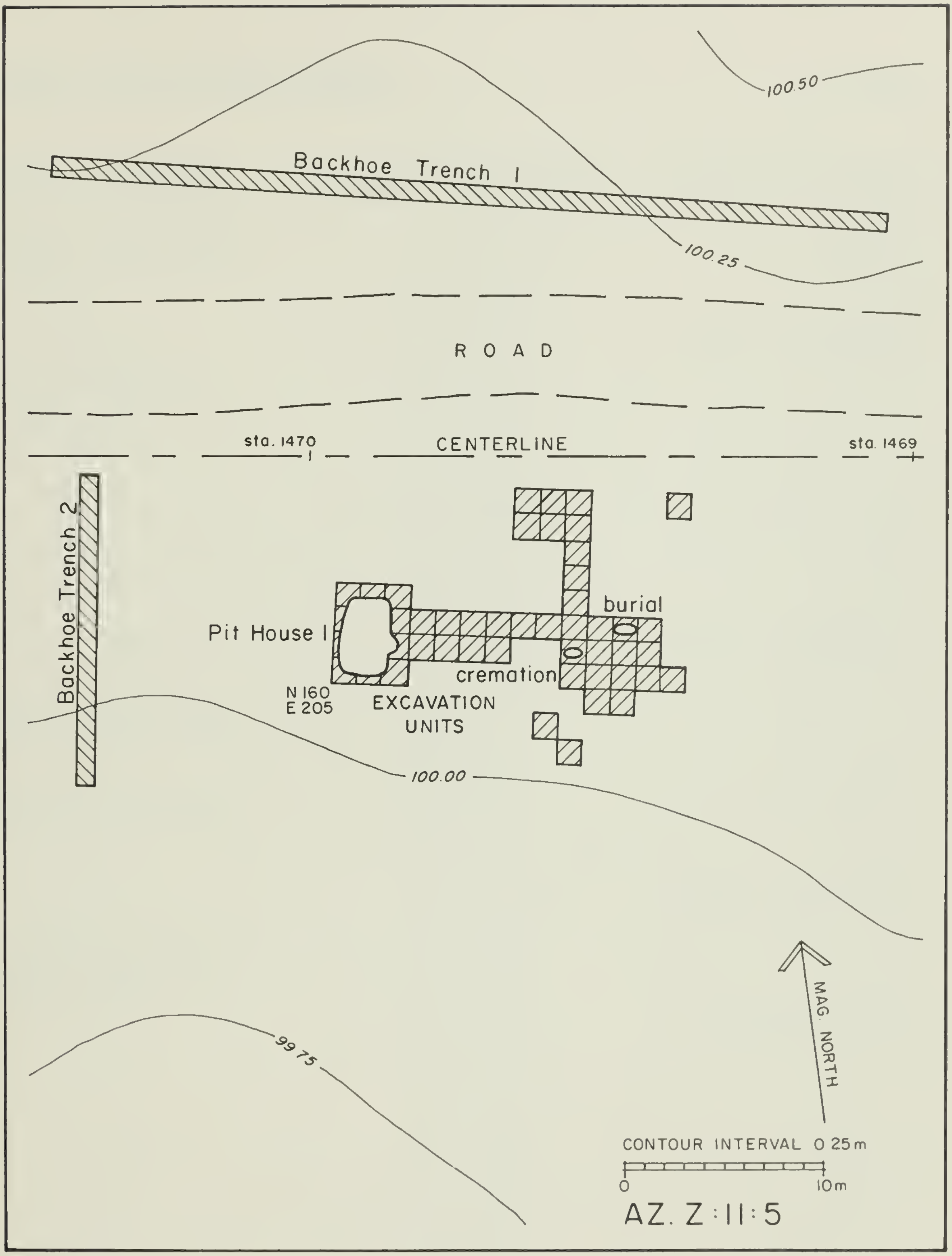


Figure 6. Map of Arizona Z:11:5.

Table 2 DESIGNATIONS AND ARIZONA STATE MUSEUM

Project Designation	Arizona State Museum No.	Site Name
Hickiwan	Az.Z:11:5	Huihikiwani - (Old Hikiwan)
Gu Vo 13	Az.Z:14:19	
Gu Vo 14	Az.Z:14:20	
Gu Vo 15	Az.Z:14:21	Kokotki (The Shell Site)
Gu Vo 18	Az.Z:14:22	
Gu Vo 20	Az.Z:14:24	
Gu Vo 21	Az.Z:14:25	
Gu Vo 22	Az.Z:14:26	
Gu Vo 24	Az.Z:14:27	
Gu Vo 25-26	Az.Z:14:28	Shegoi (Creosotebush)
Gu Vo 27	Az.Z:14:29	
Gu Vo 28	Az.Z:14:30	Bos Bosque (Cow Thicket)
Gu Vo 29	Az.Z:14:31	
Gu Vo 31	Az.Z:14:32	Gu Vo Waw (Kerwo)
Gu Vo 32	Az.Z:14:33	Gu Vo Hiktani (Big Pond Wash)
Ali Chuk 1-2	Az.Z:14:34	
Ali Chuk 3	Az.Z:14:35	
Ali Chuk 4	Az.Z:14:36	
Ali Chuk 5	Az.Z:14:37	
Ali Chuk 6	Az.Z:14:38	
Ali Chuk 7	Az.Z:14:39	

NUMBERS FOR ALL PROJECT SITES

Project Designation	Arizona State Museum No.	Site Name
Ali Chuk 8	Az.Z:14:40	
Ali Chuk 9	Az.Z:14:41	
Ali Chuk 10-14	Az.Z:14:42	Tohbi (Cottontail)
Ali Chuk 15-18	Az.Z:14:43	
Ali Chuk 19	Son.C:2:11	
Ali Chuk 20	Son.C:2:12	
Ali Chuk 21	Son.C:2:13	
Ali Chuk 22	Son.C:2:14	
Ali Chuk 24-25	Son.C:2:15	Totoni (Ant Site)
Ali Chuk 29-30	Son.C:2:16	
Ali Chuk 31	Son.C:2:17	
Ali Chuk 32	Son.C:2:18	
Ali Chuk 33	Son.C:2:19	
Ali Chuk 34	Son.C:2:20	MaikuD (Earth Oven)
Ali Chuk 35	Son.C:2:21	
Ali Chuk 36-37	Son.C:2:22	Ge Aki (Big Arroyo)
Ali Chuk 38	Son.C:2:23	
Ali Chuk 39	Son.C:2:24	
Ali Chuk 46	Son.C:2:25	Al Jeg (Little Pass)
Ali Chuk 48	Son.C:2:26	
Ali Chuk 49	Son.C:2:27	

but chipped and ground stone were also present.

A blade-maintained road passed through the site just north of the right-of-way centerline. In addition, dikes just north of the road helped prevent seasonal sheet flooding which could wash out the road. These dual factors have disturbed and disrupted the cultural material somewhat.

Procedures

The site was located by the Papago crew during the survey of P.I.R. 34 between Hickiwan and Vaya Chin. Later testing was done to determine the research potential of the site. Five 5 x 5 ft test pits were excavated to a depth between 1 and 2 feet. In one pit a hard surface was encountered one and one-half feet below the ground surface. This was determined to be a working/living level of a ramada or a pit house. The preliminary test pits were all refilled without expanding them until later, more detailed excavations could begin.

In the excavation phase, the site was mapped and an area 200 ft east/west by 75 ft north/south was surface collected before digging. Initially 5 ft squares were excavated in 3 to 6 inch levels in and around the test pit where the hard surface had been encountered. Subsequently, based on surface collections, four backhoe trenches were placed in areas where we hoped to detect subsurface features.

Four features were encountered by the excavators. Each feature was labeled according to the site's grid and the excavation's own grid and depth designations. Inside the pit house, the 5 ft grid was generally maintained, while some areas were also given distinct locational designations.

Features

Pit House

Site excavation began in the test pit where the hard surface had been encountered. This area was expanded, and a pit house (Fig. 7) was identified by its floor and walls of hard packed clay. Trash was collected from

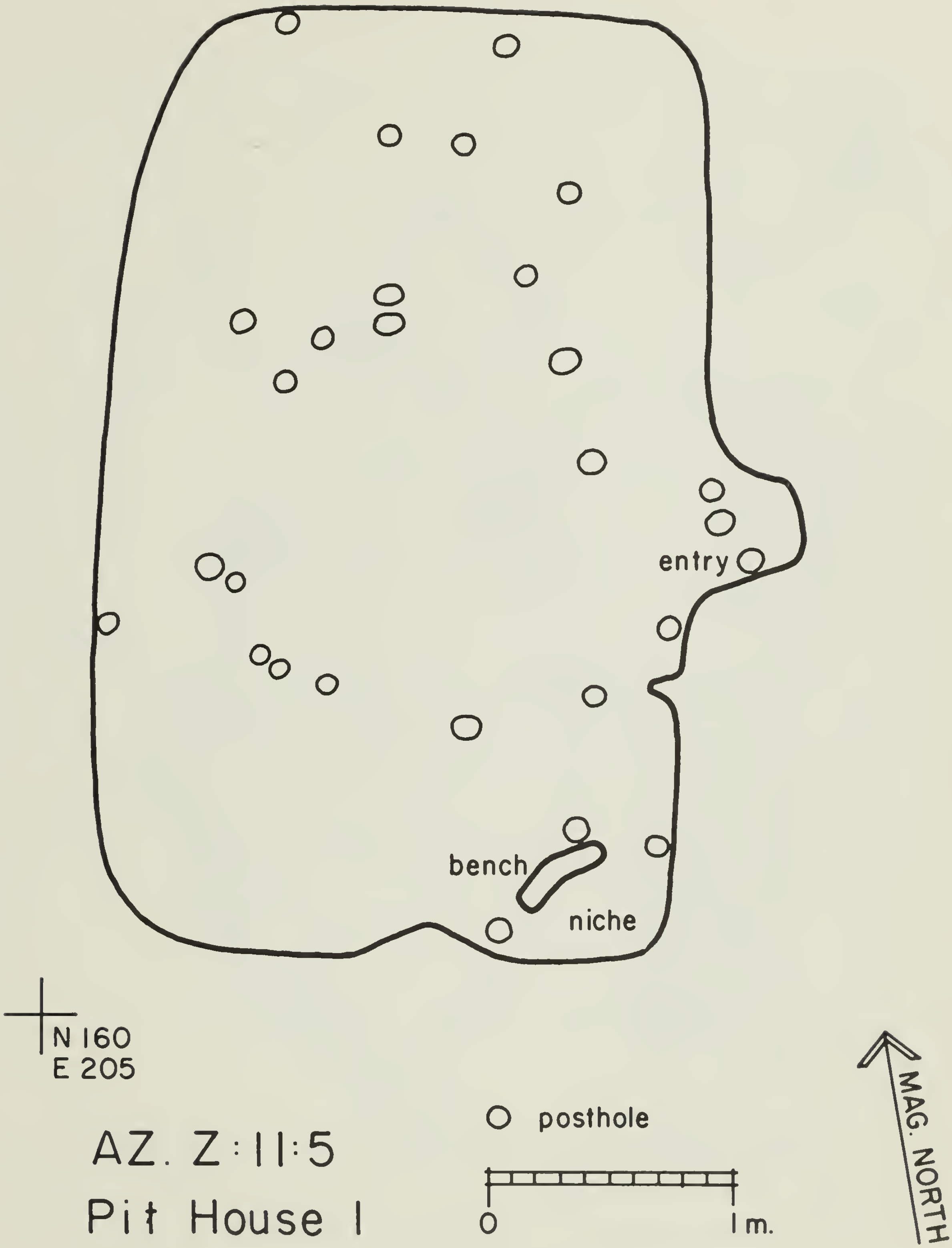


Figure 7. Arizona Z:11:5, Pit house 1.

the house floor, postholes were identified and two hearth areas (one cleaned out during testing) were located. No structural or perishable elements were present. In the northeast corner a dark lens was evident just above the floor but did not extend over the entire house.

A total of 29 postholes were detected, their orifice diameters averaging between two and three inches. Elevations were taken at the highest detection level of the posthole rims. No patterns were definable either in posthole locations or elevations. Detection elevations were also taken on the upper edge of the pit house wall, as well as on the pit house floor. The upper edge of the wall was approximately six inches below the present ground surface, with the pit house floor one and a half feet below the present ground surface. The floor area was essentially flat, rising slightly in the south, particularly in the southwest corner. The long axis of the 15.5 by 10 foot house was oriented north/south with a stepped doorway centered on the east wall.

Additional structures were noted in the pit house. A niche was located in the southeast corner (Fig. 7). Directly in front of it was a bench. This was suspected to be a specialized activity area although no particularly different set of artifacts was associated with it. Two hearths were also recorded; one was in the northeast corner located in the initial test pit. It was a small shallow pit (approximately nine inches wide and six inches deep) with ash but no charcoal. The central hearth was not a depression and contained no charcoal; instead, it was a cluster of large rocks with an abundance of ash in and around them. No sub-floor probing was completed since the Papagos in the Hickiwan district decided to protect and preserve the pit house for the benefit of future generations.

Hearth and Burned Body

Thirty-five feet due east of the pit house door, a hearth and burned human skeleton were excavated (Fig. 8). These are viewed as a single integral feature because the charcoal from the hearth was both above and below the skeletal remains. The hearth consisted of several large charcoal logs and wood fragments scattered over an area about two and one-half feet

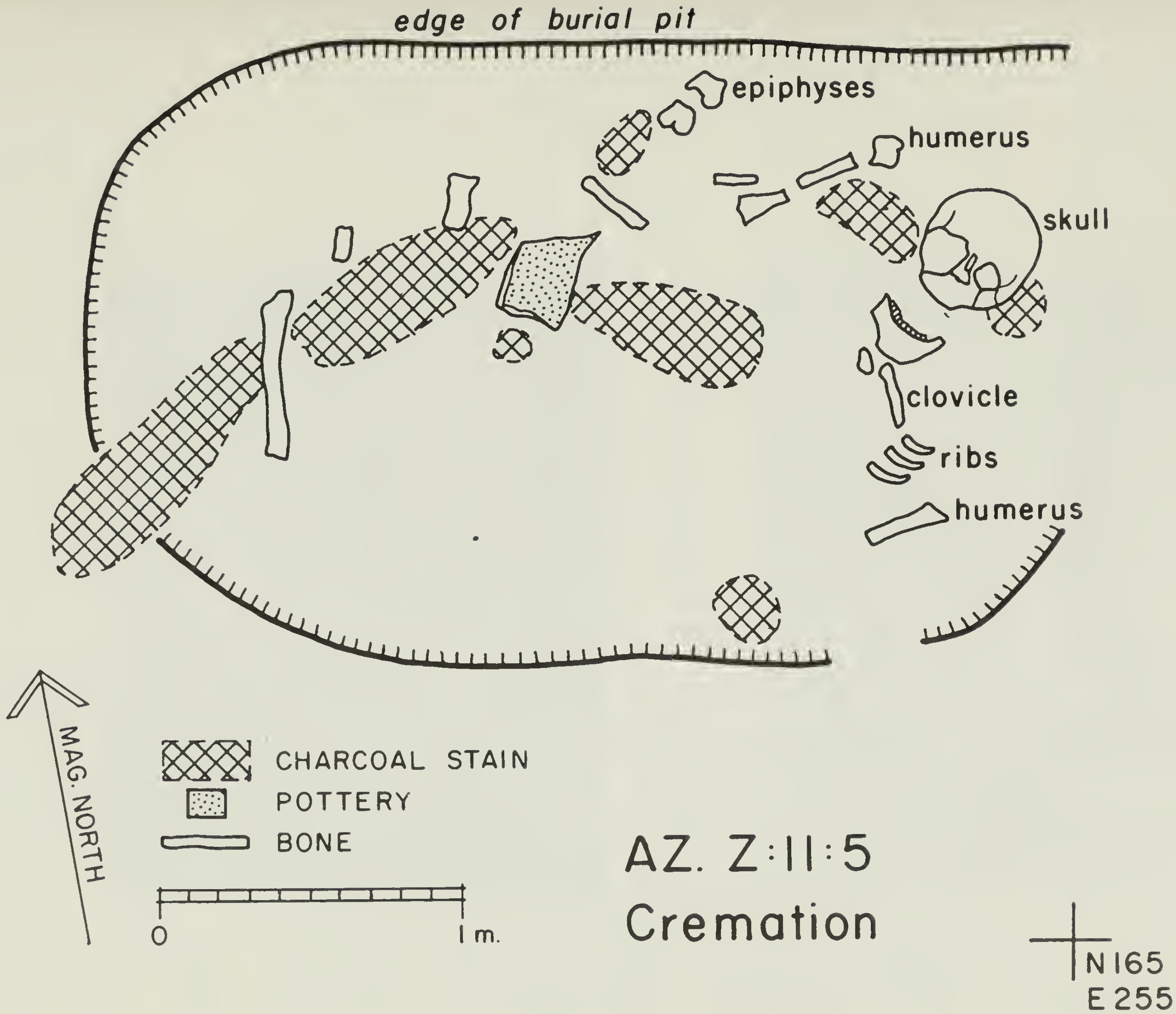


Figure 8. Arizona Z:11:5, Cremation.

north by three and one-half feet east, with very few rocks included. In the hearth was an inverted Gila Plain bowl, cracked but still in large pieces. Throughout the hearth were other sherds probably of the same bowl. Beneath the bowl was a charred human skull, the base of which was directed toward the hearth.

In cleaning the hearth, some charred and burned post-cranial bones were also found. This skeletal material was intermixed with the charcoal, neither solely above nor below it. The bones were laid out basically in anatomical position, indicating that an articulated body had been burned. But because of this burning and the fragmentation of the bones, it was difficult to determine if the body was supine, semi-flexed or flexed. It appears that one of the latter two is likely because of the restricted size of the bone recovery area.

Less than one-half of the skeletal material was recovered. (See Appendix IV.) Perhaps most of the omitted parts had been reduced to ash by the firing and, therefore, intermixed with the wood ash in the hearth. The skull was charred, except for the mandible which was heavily burned. This may indicate that the pot was inverted over the head before or during firing.

No actual burial pit was identified during excavations. After the hearth and bones were removed, the area below the feature was carefully troweled, revealing a slight, vague depression approximately 2 ft north/south by 3.5 ft east/west. It did not appear to be an excavated pit for the body, but rather a heavily-used, cleared area for the hearth (Fig. 9).

Burial

Ten feet northeast of the hearth and the burned body was a supine burial (Fig. 10) with its head to the east. During excavation a pit was looked for, but never detected. The fill for the burial was the tan alluvium found all over the site. No distinct offerings were found with the body; a few small plainware sherds were removed, but they were probably intermixed with the fill. The front of the skull, the highest point of the burial, was approximately 10 inches below the present ground surface.

a. Hearth with partially exposed body.

b. Hearth and burned body.

Figure 9. Arizona Z:11:5.

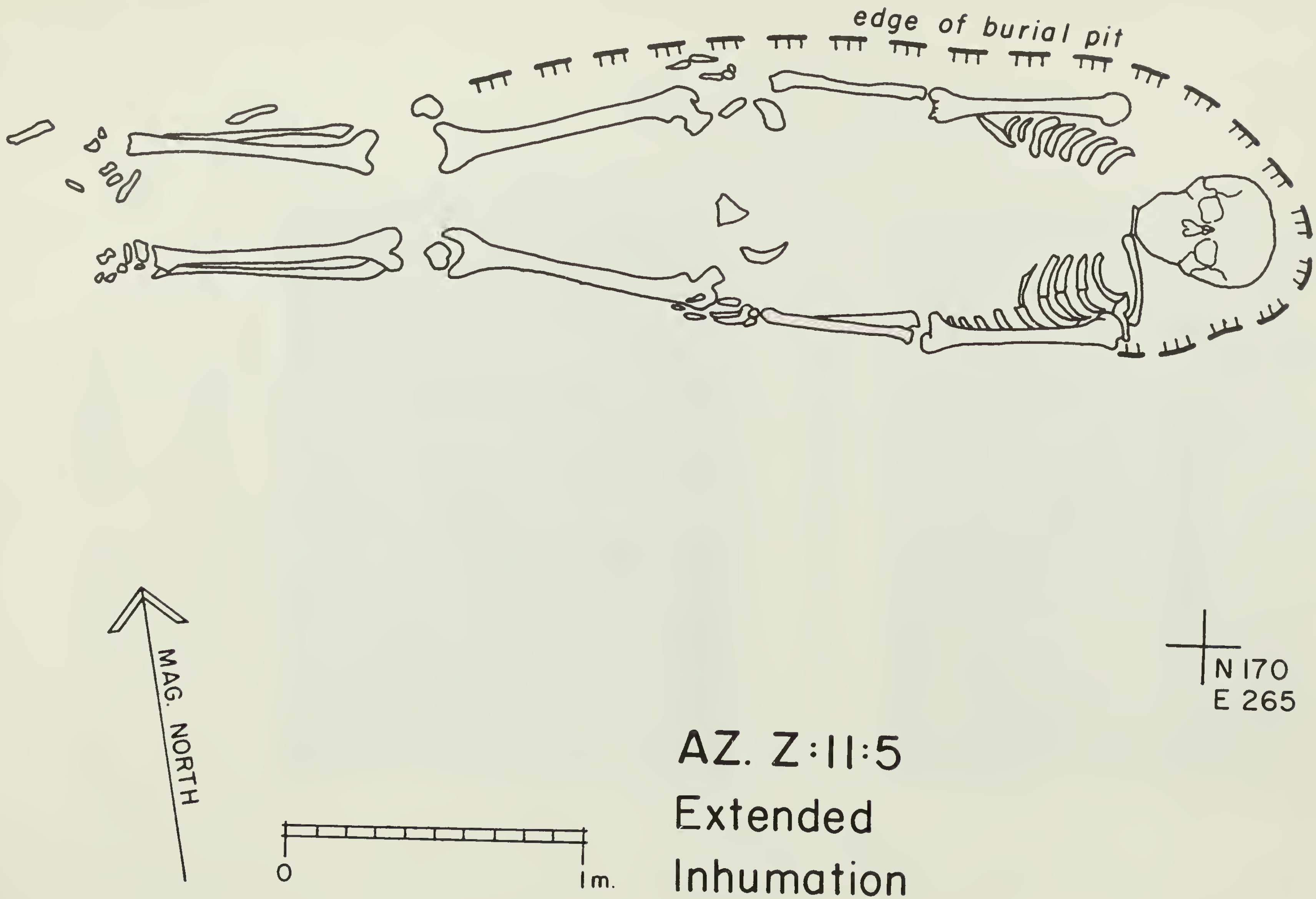


Figure 10. Arizona Z:11:5, Extended inhumation.

This level was estimated to be five to six inches below the ground surface at the time of interment.

Interpretations

Although only one house was located, the quantity of cultural material suggests there are probably several more in the immediate area. Excavations were extended from the features, in search of other subsurface concentrations, and four backhoe trenches were put in the right-of-way, to look for structure outlines. Being restricted to a narrow right-of-way severely limited the investigations.

The amount of material scattered on the surface, coupled with the findings in our excavation, clearly indicate the presence of at least a small village or rancheria type of settlement. In many of the excavation units--above the burial, surrounding the hearth/burned body and at the pit house's upper rim--a hard area was noted four to six inches below the present ground surface. This level was probably the habitation surface at the time of occupation (Fig. 11).

KOKOTK1, "THE SHELL SITE" - Az.Z:14:21

Setting

Arizona Z:14:21, is located on the northward slope of a rise along P.I.R. 1, 4.4 km (2.7 mi) south of U. S. 86, near the eastern portion of the Gunsight Hills. Elevation is 695 m (2,280 ft), and the land slopes gently to the north with drainages forming Sikort Chuapo Wash. No major washes cut the site, but one forms the eastern and southern boundaries. The soil varies, the southern (higher) being very rocky, with numerous basalt cobbles and an expanding desert pavement. At the northern end, the earth has a light gravel scattering. The soil is a sandy/silty tannish alluvium and is firm but not yet crusty like the desert pavement to the south, where the soil surface is lowering and hardening due to wind and

Figure 11. Pit house excavations at Arizona Z:11:5.

water erosion. The biotic zone is Lower Sonoran. Vegetation is dominated by creosote and bursage, with ocotillo, saguaro, cholla, paloverde and mesquite present in smaller quantities.

Site

Cultural material occurred randomly over the 790 m (2,500 ft) length of the site and beyond the width provided by the 30 m right-of-way. The site was divided into three observable loci for testing and subsequent investigations. No features or structures were located on the surface, in or out of the right-of-way, so the site was identified by chipped and ground stone, pottery and shell, scattered and clustered on the surface.

The loci had different amounts of material present. Locus A, the smallest and most southern, consisted mainly of sherds lying on desert pavement. Nearby are basalt outcrops, one of which had been used as a quarry. Downslope about 215 m (700 ft), Locus B was situated, with only its western margin in the right-of-way. Two main clusters were present with a lighter scattering connecting them. The most concentrated portion of this cluster of shell, sherd and stone extended east of the right-of-way. Locus C extended 230 m (750 ft) north/south along the right-of-way and at least 30 m to the east (Fig. 12).

Procedures

The site was first recorded by the Papago survey crew on the initial P.I.R. 1 survey. Because of the quantity of surface material, test pits (2 m squares) were placed in each locus to help develop further research strategies. The results were to some extent surprising. In Locus A, no artifacts lay below the crusty soil surface, and at locus B, where there was no soil crust, artifacts were only surficial. On the other hand, at Locus C one test pit had a small amount of material to a depth of 20 cm, and another test pit had abundant material in the upper levels with lesser amounts continuing to a depth of 110 cm. Obvious conclusions were to plan

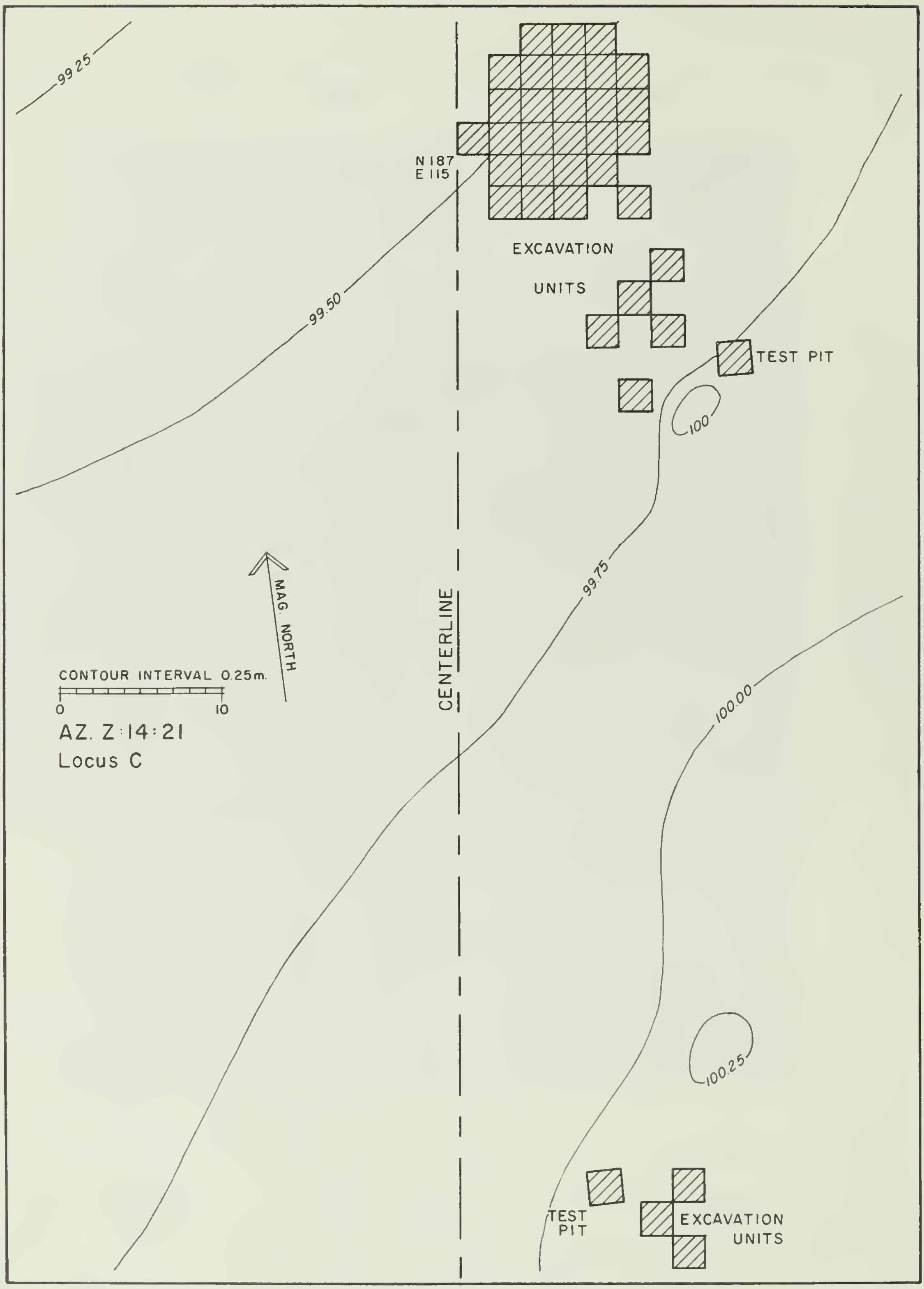


Figure 12. Map of Arizona Z:14:21, Locus C.

further excavations at Locus C and surface collections at both Loci A and B.

In Loci A and B surface collection and mapping were the only further investigations. At Locus B, clearly only the western edge of a much more intense activity area existed.

When Locus C was revisited with an excavation crew, it was first gridded in 5 m squares, and the east 20 m of the right-of-way was surface collected to decide where to put additional test pits. Excavations were then placed near the deep test pit, but the results were disappointing because cultural material was not abundant at the expected depth. Two meter square units were also opened in a wider area (8 x 10 m), especially where a surface concentration was noted in the earlier collection. The latter area was productive in sub-surface investigations. Although a pit house or some other type of structure was suspected, no structures or features were located. Excavations were also conducted near the other test pit at Locus C. Cultural materials were found a little deeper than before, but still no structures or features were encountered.

Interpretation

Discoveries at Kokotki indicated the presence of a structure, so excavations were oriented toward finding one. Once it was thought a floor had been encountered. This may have been so; however, because work was done during the rainy season and the alluvial fill was alternately moist and dry, accurate detection work was extremely difficult. No indications of a well-packed floor were present, and, from the textures observed, it was impossible to follow a surface in the homogeneous fill.

A quantity of ceramic material was recovered, primarily plain brownwares. Stone was abundant, most of it secondarily flaked material. The most interesting resource was the shell artifacts; their abundance and quality of manufacture lead us to believe that the site's inhabitants participated in a shell exchange system. (See the discussion of shell.)

The land near Kokotki was flat and may have been suitable for agriculture. The drainages carry abundant run-off, and sheet flooding is rampant. Strategically placed water control devices could allow floodwater farming in the area. Hoe-like artifacts found at the site could indicate that farming was a means of subsistence. The material recovered, and similar manifestations in the site area (outside the right-of-way), indicated a small extended village or rancheria-type settlement would have been present. This is one of the most interesting, important and frustrating sites in the project corridor.

SHEGOI, Az.Z:14:28

Setting

Arizona Z:14:28 is situated 8.8 km (5.5 mi) south of Highway 89 and 7.2 km (4.5 mi) north of Gu Vo. Located at an altitude of 683 m (2,240 ft) on an alluvial plain, the site slopes slightly to the west-northwest. To the north about 6.4 km (4 mi) is the broken hill country and low lava-capped mesa of the Gunsight Hills. Directly south of the site 1.6 km (1 mi), lies the fault-block structure of the Gu Vo Hills. Extensive erosion of the Gunsight Hills' granite and gneiss has formed wide outwash fans in this area. The fill at the site is a tannish alluvium, somewhat sandy with little clay content. A series of small gullies dissect the site and drain southeast into the San Simon Wash. Results of rodent activities are noticeable.

The vegetation in the vicinity of the site is sparse, with mixed desert riparian and creosotebush-bursage associations (Fig. 13). Cholla and creostoebush predominate, but mesquite and occasionally paloverde may also be observed. Saguaro are confined to nearby rocky outcrops.

Figure 13. Excavations at Arizona Z:14:28. Creosote and cholla predominate in the site area.

<u>Site</u>

The site is a dispersed sherd and lithic concentration which stretches for one-half kilometer. Two specific loci were independently collected and tested (Fig. 14 a, b); other material was lightly scattered between these two areas. No surface features or structures were identified. The archeological resources consisted primarily of plain brownware sherds, a small number of painted potsherds, chipped stone, numerous shell pieces and several fragments of manos and abraders.

Procedures

Material was equally present within and outside the right-of-way. Within the right-of-way, 5 x 5 m grids were staked out, numbered and collected. Subsurface testing was initiated where concentrations of sherds and stones were pronounced. At the northern Locus A, a 2 x 2 m test pit and eight 2 x 2 m squares were excavated to an average depth of 30 cm. Two 2 x 2 m squares were placed at Locus B, where material clustered in the southern section of the right-of-way. A third test was made in the west-central portion of the locus. On a dispersed sherd area a final 1 x 8 m trench with a central 2 m balk was dug to a sterile level. Throughout Locus B, cultural materials were deposited down 30 to 40 cm. All excavation squares were dug in 10 cm units since no natural stratigraphy was observed. Material was screened through one-quarter inch wire mesh. Possible features were carefully troweled but none were confirmed as hearths, floors or structures. The site was photographed and mapped before fieldwork was completed.

Interpretation

The two loci at Shegoi are so dissected by small washes that no interrelationship between site areas can be determined. Sheet wash has displaced and removed much of the material from the site; perhaps a considerable amount of trash has been lost to this erosion. The material remaining suggests a small dispersed settlement. It was probably seasonally occupied in the late prehistoric period, and villagers intensively collected wash resources or used floodwater for agriculture.

BOS BOSQUE, Az.Z:14:30

Setting

Arizona Z:14:30 (Fig. 15) is located along P.I.R. 1, 11 km (6.8 mi) south of U.S. 89 and 6.7 km (4.2 mi) north of Gu Vo. The site is at an

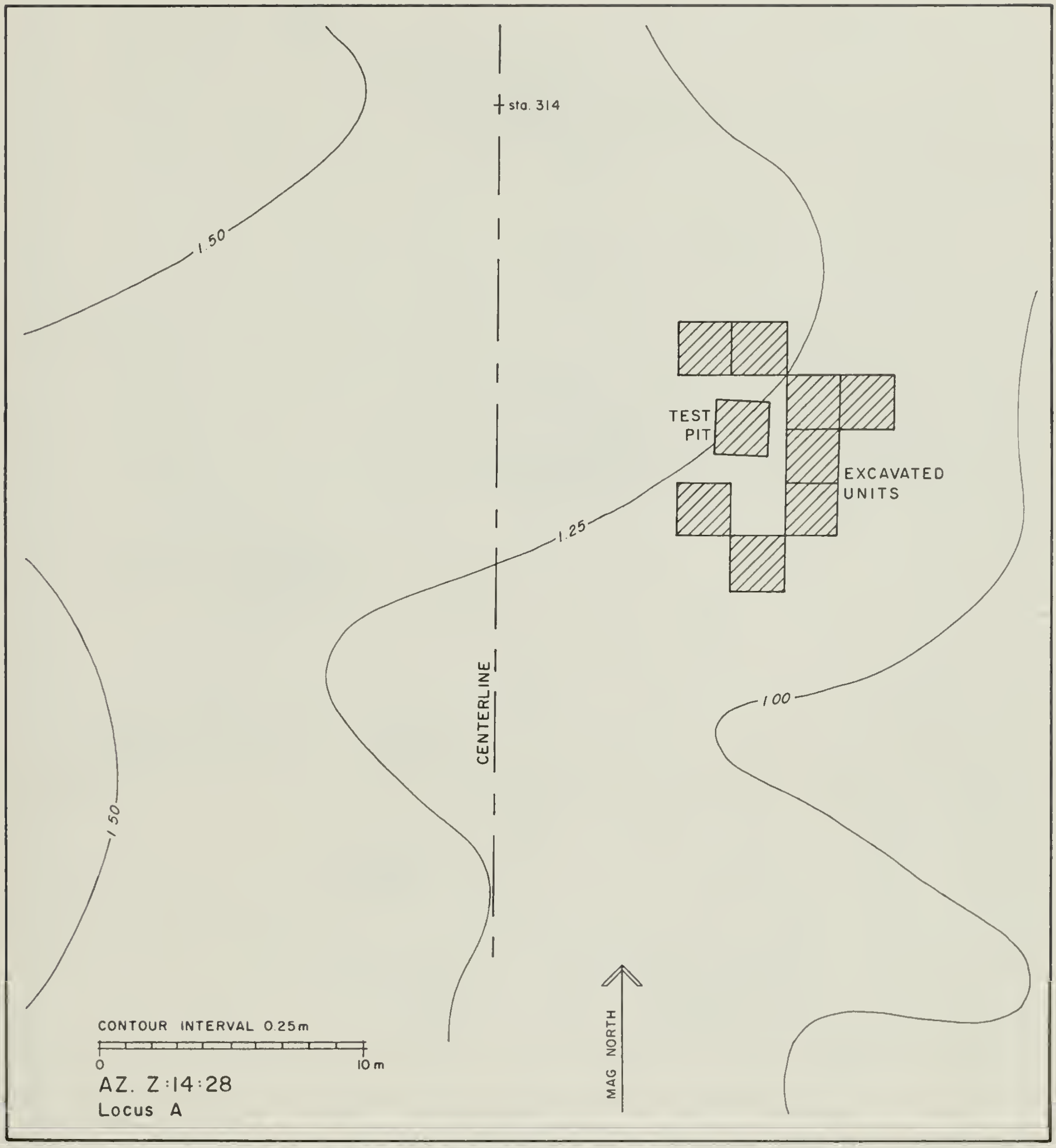


Figure 14. a. Map of Arizona Z:14:28, Locus A.

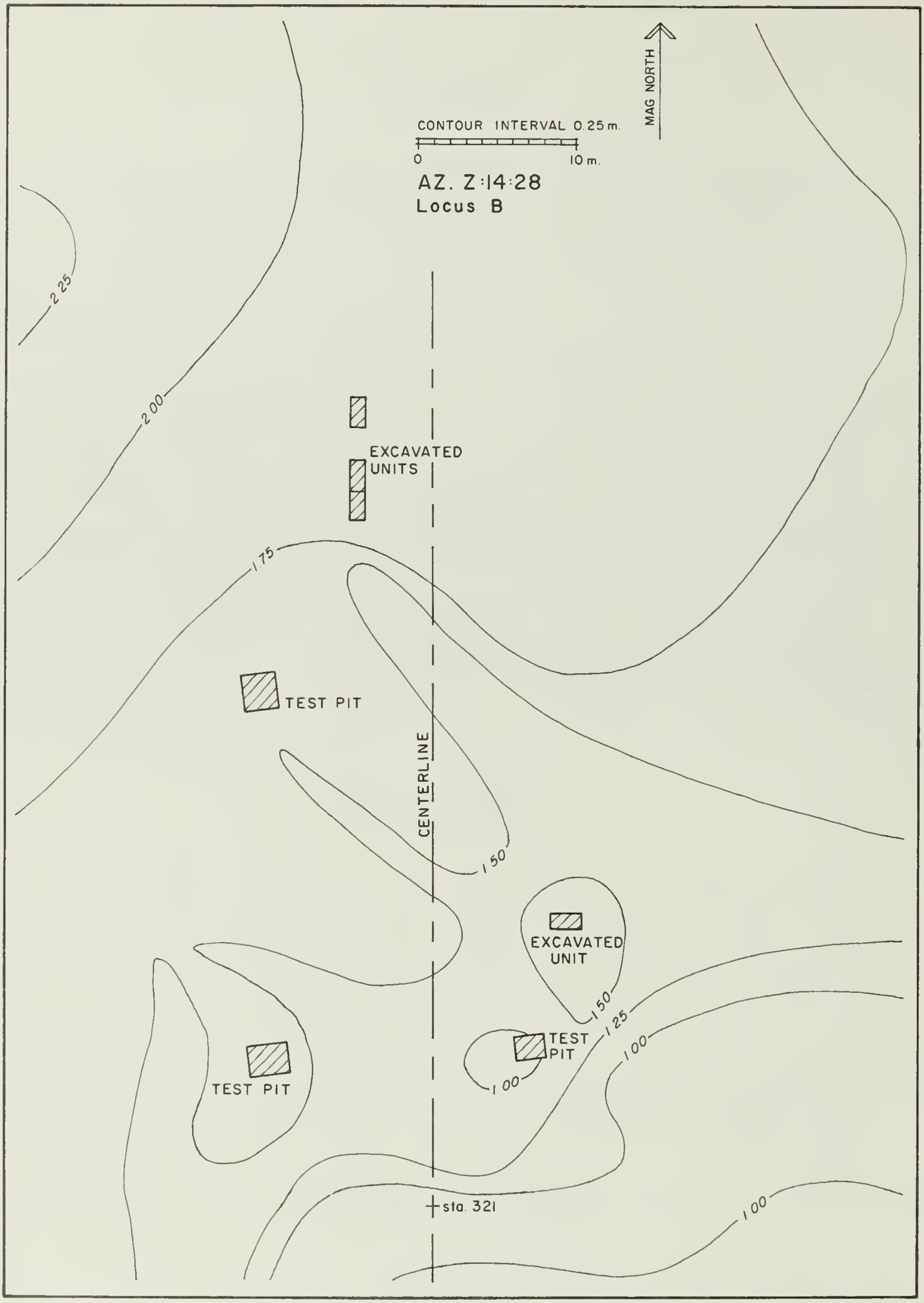


Figure 14. b. Map of Arizona Z:14:28, Locus B.

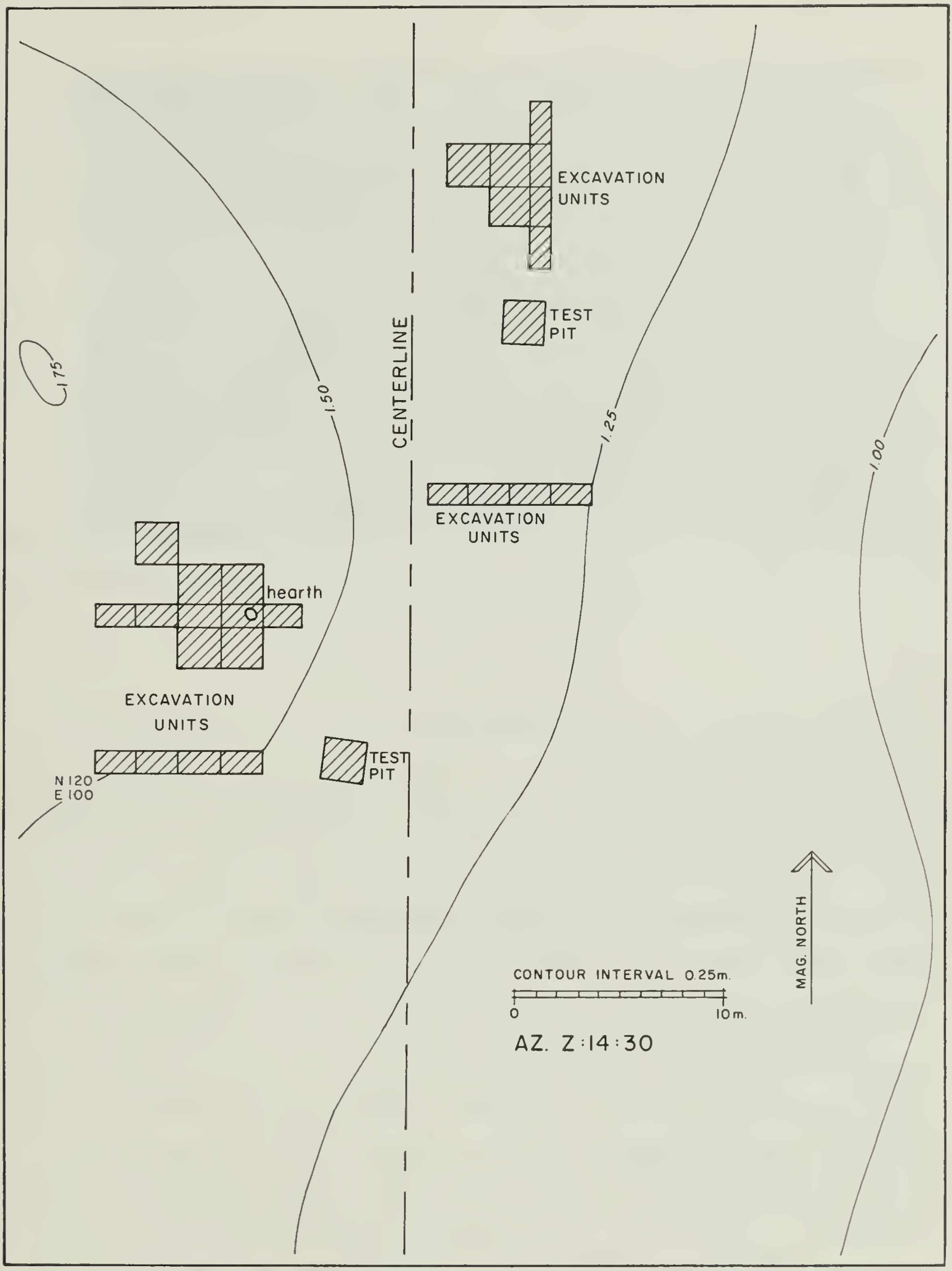


Figure 15. Map of Arizona Z:14:30.

elevation of 677 m (2,220 ft), in a generally flat area. The Quijotoa Valley stretches to the south and east, sloping towards San Simon Wash approximately 21 km (13 mi) away. To the north are the Gunsight Hills, and to the west is the northern tip of the Gu Vo Hills. The area adjacent to the site along the east is a low-lying, almost ground level, basalt outcrop.

Fill at the site is the expected tannish alluvial silty clay. Rodent burrowing is abundant in the northwestern portions of the site and is at least partially responsible for mounds around a cluster of creosote bushes. Luxuriant mesquite and paloverde grow in a large unnamed arroyo which forms the northern boundary of the site. On the site itself and in the general area vegetation is dominated by creosote and bursage. Other plants are cholla, saguaro, ocotillo and scattered mesquite and paloverde. In the Gu Vo Hills, about 200 m west, are brittlebush and organpipe cactus.

Site

The site area investigated extended only 30 m (east/west) by 60 m (north/south) in the right-of-way. There was a light scattering of cultural material over a broader range, but no other dense concentrations were located. Neither surface features nor structures were located on the site. The locus is essentially flat with a slight rise in the northwest portion; this seemed to be a rodent disturbance around a creosote cluster rather than a small trash mound. Although a few sherds were eroding out of the mound, excavation there recovered only scant, shallow material.

During excavations one hearth was recorded in the west central area, 20 to 30 cm below the present surface (Fig. 16). The diameter of this feature was about 45 cm. The hearth's construction was indistinct; a rock alignment seemed present only along the west side. The few artifacts found were four brownware sherds, three mano fragments and three metate fragments. A radiocarbon sample was collected, but no burned ring or basin was detected so archeomagnetic sampling was not possible (Appendix VII). No major material clusters, features or structures were found in association with the hearth.

Figure 16. Hearth at Arizona Z:14:30.

Procedures

The site was initially located by the Papago Survey Crew and, after a field check, was recommended for testing. A larger dispersal of material in the right-of-way had originally been noted, but at the time of testing the smaller area was tested because of the relative density of its cultural material. Two initial test pits were excavated with a large enough return to warrant further work.

Upon returning to the site for excavation, an area 60 x 30 m was gridded in 5 m units, then surface collected and mapped. Excavations were based on surface manifestations. Areas of both great and meager surface returns were trenched end to end, using 1 x 2 m units, and then excavated in 2 x 2 m units. The only feature located was a hearth (described above), which was carefully troweled, brushed clean and recorded. Areas around the hearth were exposed to look for other features, activity floors or areas, but to no avail.

Interpretations

This site is probably related to or roughly contemporaneous with other sites excavated along the P.I.R. 1 right-of-way, being similar to others in the general area. The quantity of cultural material retrieved from the site indicates a small seasonal village type of settlement, lasting for perhaps a decade or so, rather than a long-term village center. Flat areas would provide good farmland, and washes provide the runoff necessary for farming. The general environment should have proved adequate for small scale subsistence agriculture. The undergrowth and hills to the north and west are ideal areas for small animals. Vegetal foods like cactus fruit, paloverde and mesquite beans were readily available. To the northwest, across the wash and near the mesquite/paloverde bosque, are several bedrock mortars in low basalt outcrops. The several fragments of ground stone on the hearth support the idea of plant processing as one means of subsistence at the site.

GU VO WAW, Az.Z:14:32

Setting

Arizona Z:14:32 is located along P.I.R. 1, approximately 2.4 km (1.5 mi) northwest of the village of Gu Vo and approximately 14.8 km (9.2 mi) south of Highway 86. The site is at an elevation of 668 m (2,190 ft) on an alluvial plain along the southeastern base of the north quarter of the Gu Vo Hills. A few small drainages running off the hills transect the site, but the only large wash is the Gu Vo Wash, which cuts around the southern end of the site and extends east-southeast for about 20.9 km (13 mi) to the San Simon Wash.

Ground cover in the area is sparse, with creosote and bursage the main growth and saguaro, ocotillo and cholla (several species) occurring occasionally. Scattered paloverde and mesquite grow mainly in drainage areas while brittlebush and organpipe cactus grow on nearby hills and

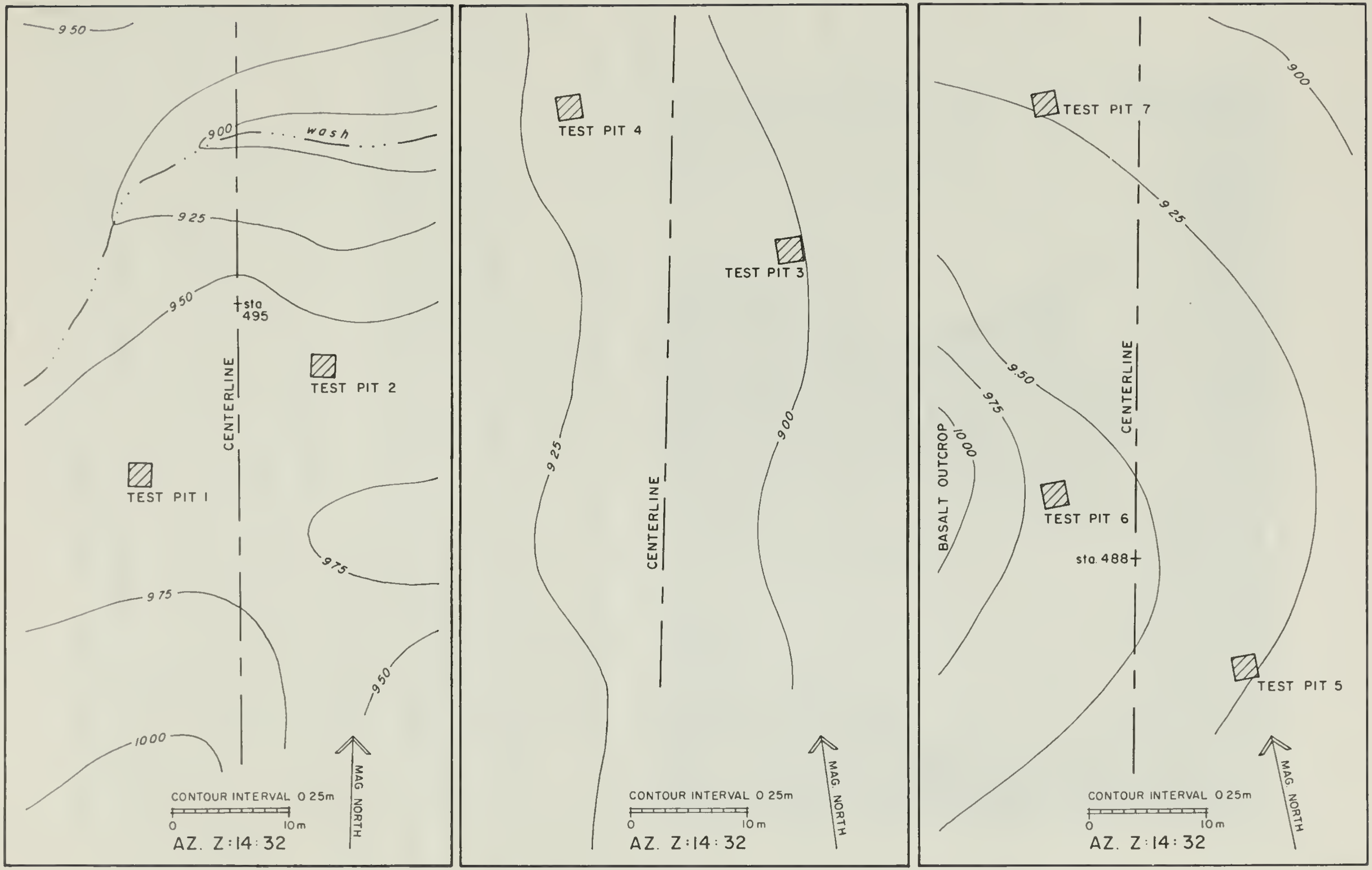


Figure 17. Map of Arizona Z:14:32, Loci A, B, and C.

outcrops. Several small areas where desert pavement is forming are void of vegetation. In all these areas, the ground is covered by basaltic gravel lying on silty, hard-packed soil.

Site

On the original survey, an area 1,006 m (3,300 ft) long within the road right-of-way was designated as a single site (Fig. 17). No investigations were conducted outside the right-of-way. For testing, the site was divided into five loci with culturally bare areas between each. Testing indicated further surface collection was necessary, especially in areas of major material accumulations. For the final work an area 390 m (1,280 ft) long and 30 m (98 ft) wide, with the southern end at the Gu Vo Wash, was collected. This area included two loci from the initial testing.

During the last part of the investigations, several short walks were taken in the surrounding area to help define the perimeter of the site. The site extends at least 400 m to the east as a sparse scatter with occasional clusters of sherd and stone material. No definite boundary was established as the material seemed to continue sporadically for some distance. To the west, the Gu Vo hills form a fairly good buffer. The material extends 300-400 m onto the bajada, but not up the slopes or on the hill tops. Some material extends around the southern base of the hills.

Along Gu Vo Wash, about 200 m west of the right-of-way, a fine-grained basalt vein was identified. It was utilized both as a quarry for chipped stone material and as a community bulletin board, as is evidenced by its numerous petroglyphs (Fig. 18).

Another area at least 800 m east/west and 1,006 m north/south was defined as a large site area dividable into many activity loci. However, our main investigations were restricted to surface collecting the narrow strip of road right-of-way, only 30 m wide by 390 m long, thus leaving the majority unexamined.

In this restricted project area, the material appeared to be of at least two time periods. Chipped stone artifacts and waste material were

Figure 18. Petroglyphs on Kerwo Cliff at Arizona Z:14:32. Quarrying debris is in the background.

scattered throughout the area; part of the area contained ceramic material, but not in the quantity or frequency of the stone. No cultural features were located in the right-of-way; however, just off the right-of-way there are several bedrock mortars in two small outcrops.

Procedures

The only excavations conducted in the site were the initial tests. Twelve 2 x 2 m test pits were excavated with minimal results (Fig. 19). The main archeological investigations were systematic surface collections, controlled by a 5 m square grid (30 m wide and 390 m long) starting at Gu Vo Wash and extending north, centered on the road centerline. The site was mapped with a plane table and alidade.

Interpretations

Some differences in artifact distribution were readily apparent in the field. As noted above, we sampled only a very small portion of a large, complex site area. Almost no pottery was present in the 150 m strip adjacent to Gu Vo Wash which was surface collected. Instead, it was most abundant near a large outcrop extending to the west edge of the right-of-way about 310 to 325 m north of the wash.

Separate areas were probably utilized at different time periods by people associated with various cultures, making this a multi-occupation, multi-use, multi-component, multi-temporal site. Arizona Z:14:32 seems to have been a camp area for hunting, gathering, processing, quarrying, tool manufacturing and petroglyph pecking. With the proximity of Gu Vo Hiktani across Gu Vo Wash and the present village of Gu Vo, 2.4 km away, it was correctly anticipated that an area of several square kilometers would exhibit light, scattered cultural material of varying types and ages.

Figure 19. A test pit at Arizona Z:14:32. The saguaro-covered rock outcrop in the background contained several bedrock mortars.

GU VO HIKTANI, Az.Z:14:33

Setting

Arizona Z:14:33 is located at an elevation of 668 m (2,190 ft), approximately 2.3 km (1.4 mi) west-northwest of the village of Gu Vo, at the southern base of the Gu Vo Hills' northern quarter. The land is part of a flat alluvial plain, cut by several small gullies and an occasional large wash. The site area drains to the northeast towards Gu Vo Wash, which bisects the northern end of the site area and flows southeast approximately 21 km (13 mi) to San Simon Wash.

The vegetation at the site is characterized by bursage and creosote with several cholla. Saguaro cactus is in the site area, as well as paloverde and mesquite; the latter two are mainly in washes. The northern end of the site, which abuts Gu Vo Wash, is a heavily graveled terrace, devoid of vegetation. Away from the terrace the fill is gravelly, but there is enough soil to support sparse vegetation. The area in general shows the effects of heavy seasonal sheet washing and arroyo cutting.

Site

The site area is a long narrow (365 x 30 m) corridor displaying different cultural manifestations. As a result of these aspects, the site was divided into three loci for fieldwork. Since a light scattering of mainly stone material was always found in every direction, the site extends outside the right-of-way for a considerable distance.

Locus A

This locus was the southeastern part of the site (Fig. 20). The designated area was 35 by 45 m, with concentrations of sherds, chipped and ground stone. Although sherds were seen in other site loci, this was by far the densest area.

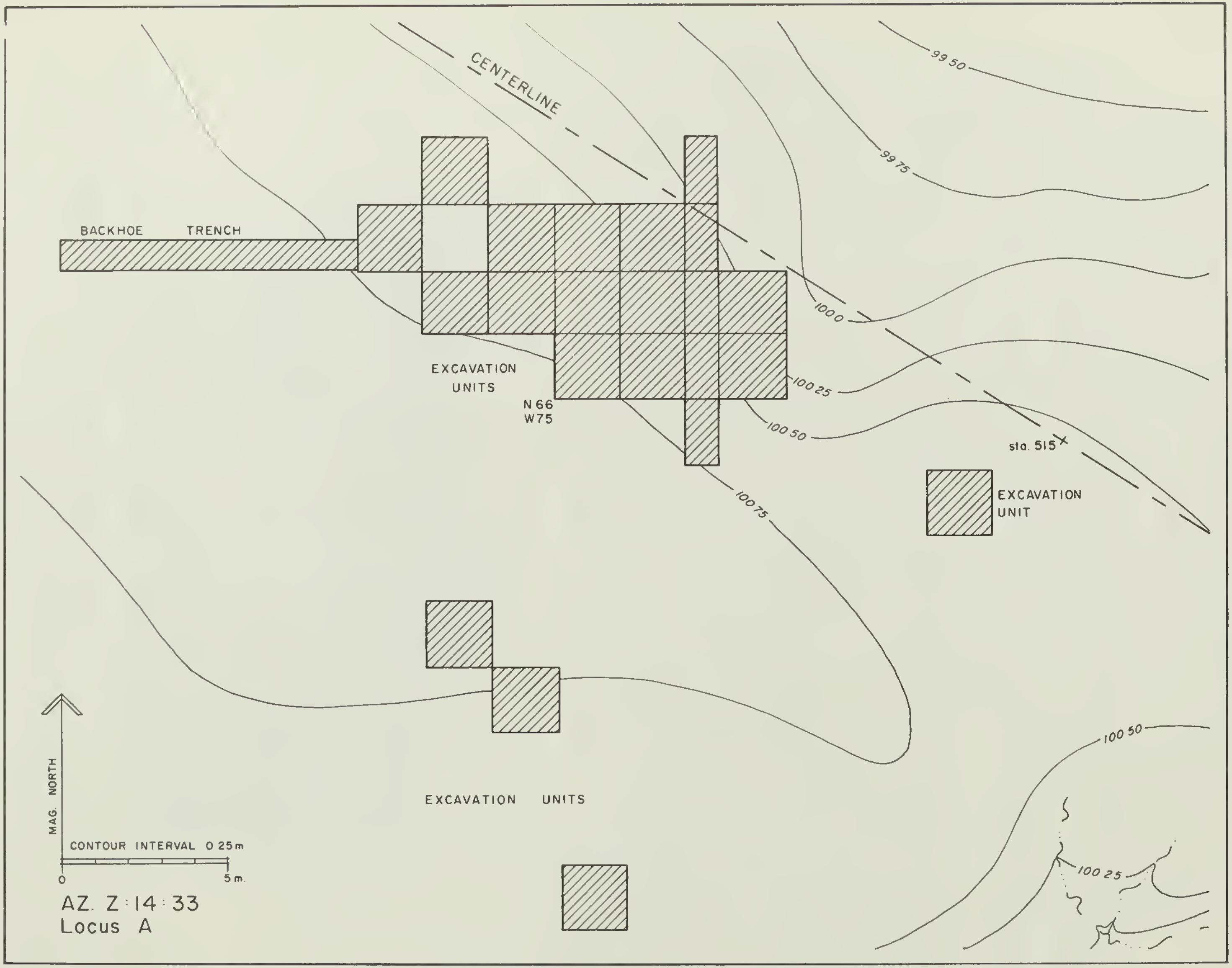


Figure 20. Map of Arizona Z:14:33, Locus A.

At Locus A vegetation is predominately bursage and creosote. The surface soil is a tan silty sand with abundant gravel and cobbles. The central area of the site is a small gravel rise which extends toward the west as a low ridge. Several drainage areas start in the site area and extend northeast from the low gravel ridge. Concentrations of material seemed to terminate near a recent wash along the southeast boundary of Locus A.

Locus B

This locus was situated at the northwestern end of the site area, adjacent to the Gu Vo Wash (Fig. 21). Two situations existed here. One was the presence of a gravel terrace with an aceramic component and no features. The other was an aceramic component (several hearths) in a low area subject to excessive washing. While no vegetation grows on the gravel rise at Locus B, there are several creosote bushes and mesquite trees growing in the lower area.

Locus C

This consisted of most of the area between Locus A and Locus B (Fig. 22). The area designated as site was 120 m (394 ft) long and 30 m (98 ft) wide. The right-of-way followed the ridge mentioned at Locus A and provided an interesting topography. The southwest half of the right-of-way was on the ridge top at a fairly uniform height. The northeast half of the area was cut by the heads of gullies extending away from the ridge. No features and very little pottery were noted at this locus. Nevertheless, because of the large quantity of scattered chipped stone, a systematic collection was necessary.

Procedure

Each locus had its own problems; thus, procedures differed slightly where necessary. At Locus A, the site was divided into 5 m grid squares, based on magnetic north instead of along the centerline. After the

surface was collected in the areas with greatest surface returns, five north/south test trenches, 1 x 2 m each, were excavated in 20 cm levels. Since generous amounts of artifacts were recovered in the initial trench, it was expanded laterally in 2 x 2 m units with 10 cm levels.

East of the trench only two units were dug. On the west material was more abundant and 11 units were excavated, ranging from 20 to 140 cm deep. The excavations in each unit were carried down to sterile soil or until artifact quantity dropped substantially. A compact tan silty gravel underlay the site area and determined the depth of cultural material. To the west of the test trench, the combined deepening gravel layer and rising ground surface dramatically increased the depth of cultural material, but no features were located. Three areas away from the main excavation block were also tested without success. All the material recovered from Locus A seemed to be from a uniform time period.

Locus B, a 50 by 50 m section, was gridded into 5 m squares. Surface collections were completed and limited excavations conducted. The material recovered from the northern part of Locus B was mainly preceramic worked stone and debitage. In the two (2 x 2 m) test squares excavated, very little material was found in the top 10 cm, and nothing was found in the second level.

The southern half of Locus B was much lower in elevation and was dissected by recent wash activity. In this area, two locations were tested, neither of which yielded significant artifacts. In one location a shallow rock concentration was bissected and tentatively identified as a hearth. No charcoal was noted, but there was a slightly darker lens beneath the feature which did not extend laterally beyond it.

Locus C, 120 by 30 m, was gridded and collected, but no excavations were made. Surface materials were scattered the entire length of the right-of-way. These were mainly lithics and sherds in three small concentrations.

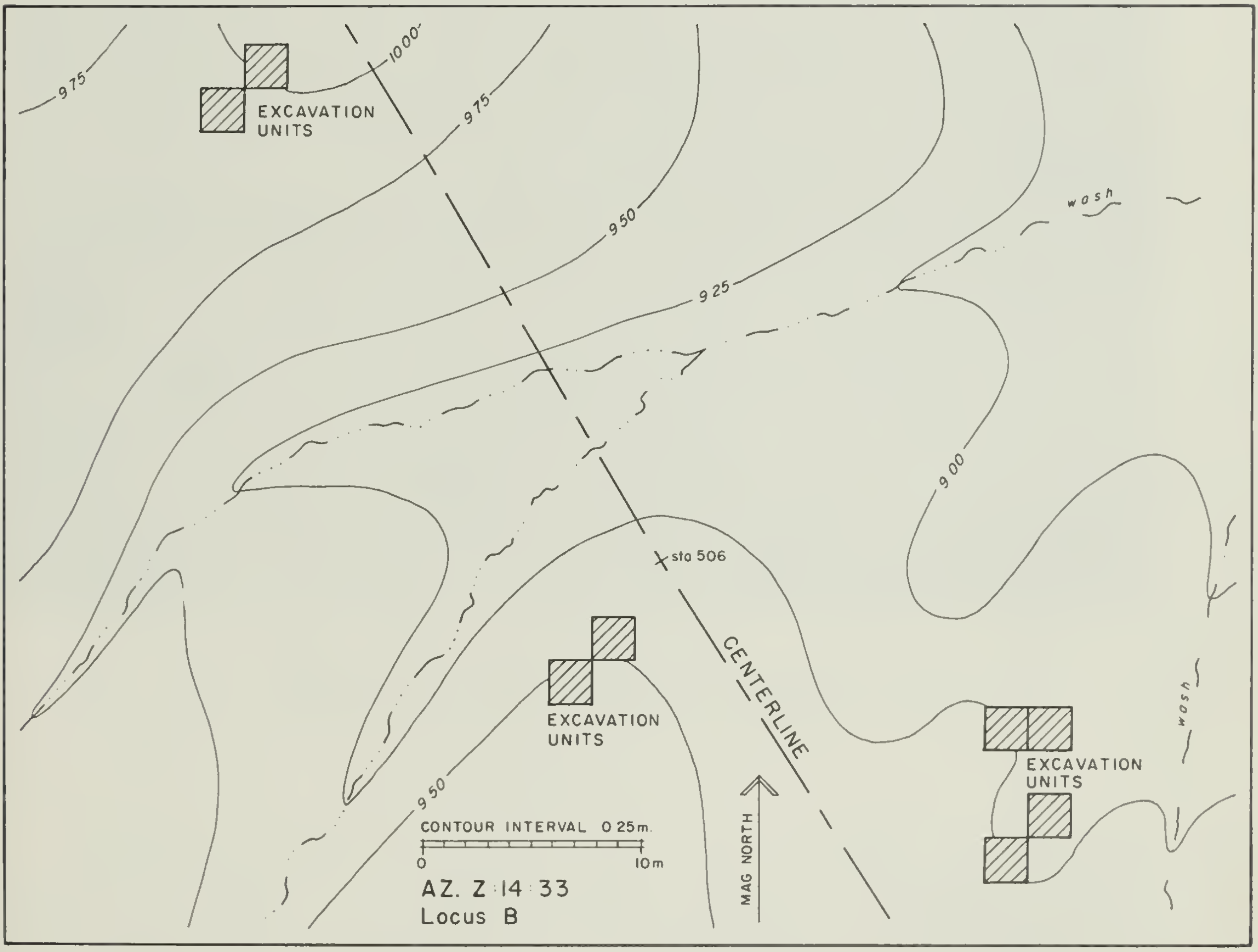


Figure 21. Map of Arizona Z:14:33, Locus B.

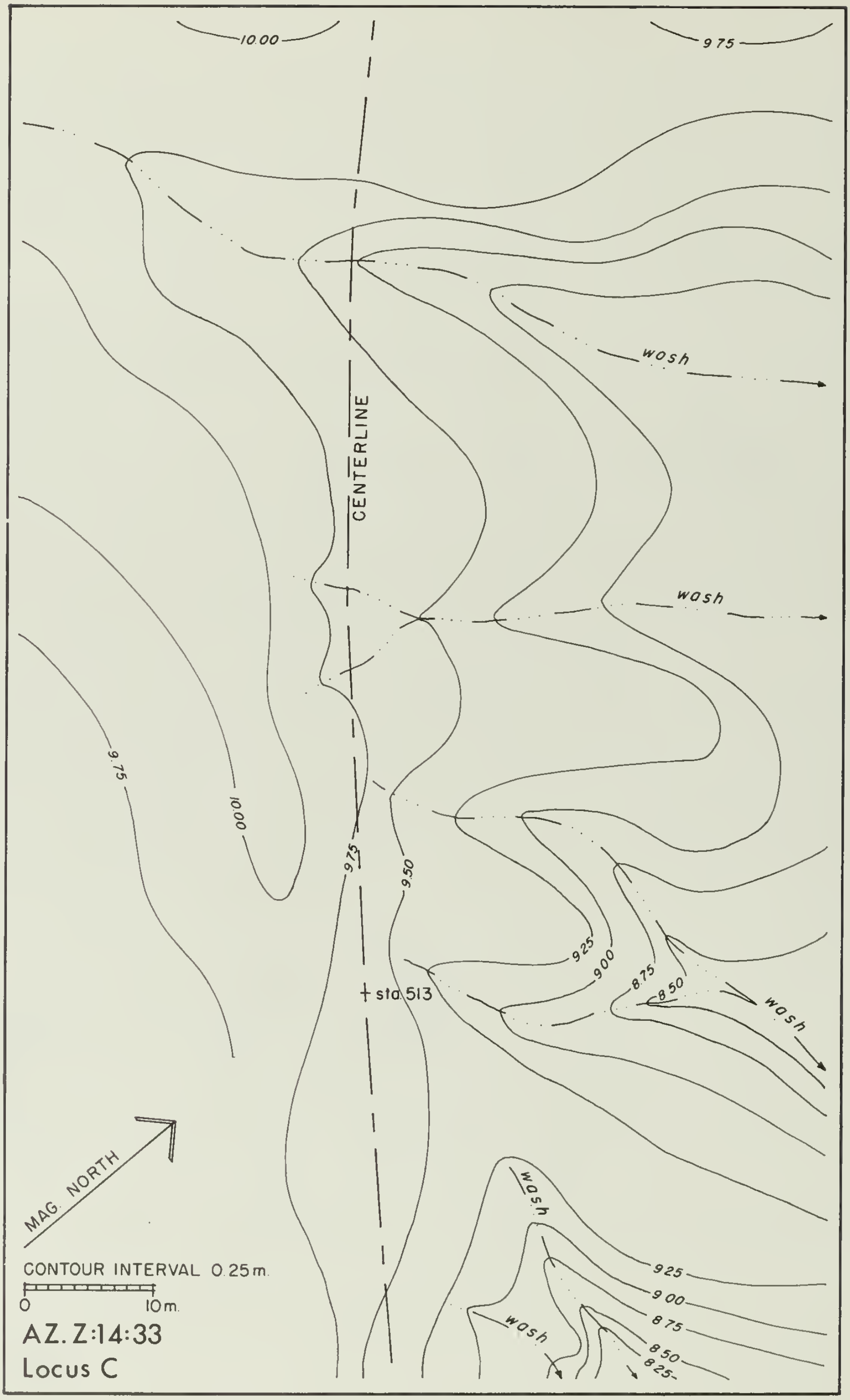


Figure 22. Map of Arizona Z:14:33, Locus C.

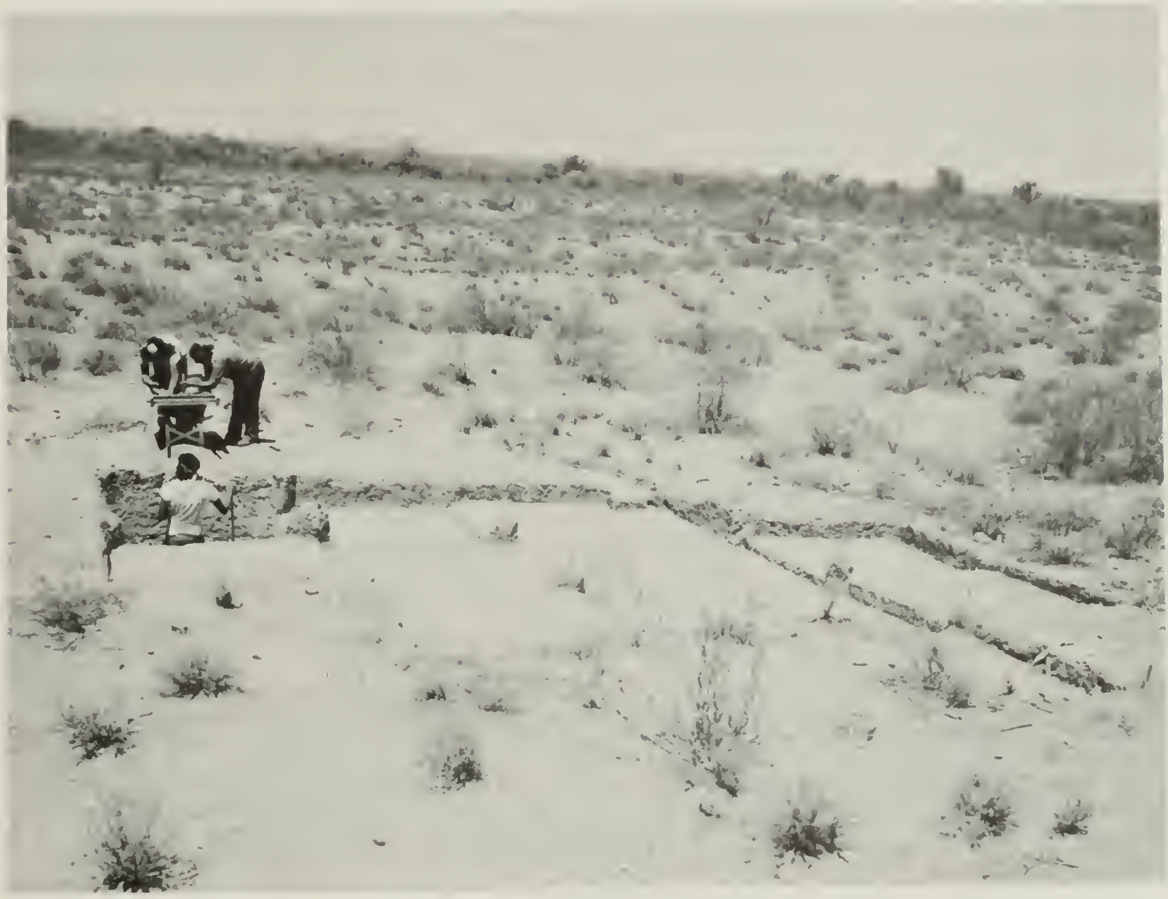


Figure 23. Excavating to a depth of 140 cm at Locus A, Arizona Z:14:33. The Gu Vo Wash is in the background.

Interpretation

Arizona Z:14:33 is a multi-use, multi-occupation site. Evidence of preceramic occupation was gathered at Loci B and C. The only structures located in the site area were hearths and trash piles. Tanque Verde pottery present at Locus A sets it apart from the remainder of the site; it also leads to speculation about continuous or recurrent inhabitation.

Controlled surface material collection enables delineation of activity functions as if the context had not been disturbed by erosion. Because of the extensive, although not always dense, quantity of material scattered over a large area and the location of the site along a major drainage, it is felt that the site was a village settlement rather than

just repeated campsite occupations. Although no features other than hearths and trash were located, it is possible that prehistoric structures left no surface indications at this site. On the other hand we might have missed house structures since the investigated right-of-way was a small portion of the entire site.

Locus A presented particular problems because of the dramatic depth of cultural material (Fig. 23). Field interpretations suggest that an old wash had been filled. However, it is unclear whether the process of filling was a natural erosion/deposition action or whether local villagers dumped their trash in a nearby gully. The soil was homogeneous and showed no evidence of being washed or blown into the gully, except at two spots about one meter below the ground surface where fill laminations were noted. The absence of any evidence of a large village or any surface indications of pottery in the surrounding area makes the idea of trash dumping from such a village untenable. Furthermore, in limited wanderings about the area, the scattered cultural material observed was predominately stone; no sherd concentrations were located. This leads us to suspect that the settlement producing the sherds was along the ridge top next to the gully and that the material was deposited in the gully by erosion.

TOHBI, Az.Z:14:43

Setting

Arizona Z:14:43 (Fig. 24) is located in the large flat alluvial Barajita Valley at an elevation of 661 m (2,170 ft), between the Ajo Mountains (4 km to the west) and the Gu Vo Hills (2 km to the east). The village of Gu Vo is 6.4 km (4 mi) north along the new P.I.R. 1. Pia Oik Wash is along the southern border of the site. The area to the west is drained from the base of the Ajo Mountains by several small washes and gullies that feed into Pia Oik Wash to the east of the site. Sheet flooding in this area is common and severe during summer rains. Vegetation in the area is predominately creosote, with a few scattered cholla

and saguaro. In the wash areas are mesquite and paloverde bosques. On the site itself the only vegetation is creosote.

Site

The distinguishing feature of this location was a concentration of small (less than 2 cm diameter) sherds. Nine small loci were located along a 3.3 km (2 mi) extent of the right-of-way in the areas of densest concentration. However, the material at all these loci was so fractured that redeposition from a more intense concentration west of the road was immediately suspected as their source. No surface features were located in the right-of-way area.

Procedures

An area 60 x 15 m was gridded into 5 m squares for surface collection. Then 10 units (1 x 2 m) were designated for excavation in the areas of greatest surface returns. Of the 10 units, seven were excavated through a second 10 cm level which showed both uniform soil change and significantly fewer artifacts. The fill changed from a light tannish alluvial silt in the first level to a reddish silty clay in the second.

Interpretation

The small, broken material recovered was the result of natural, secondary deposition. It is still suspected that either a larger village site or several smaller sites are located to the west of the right-of-way and that erosion from that area redeposited the cultural material located by the Project.

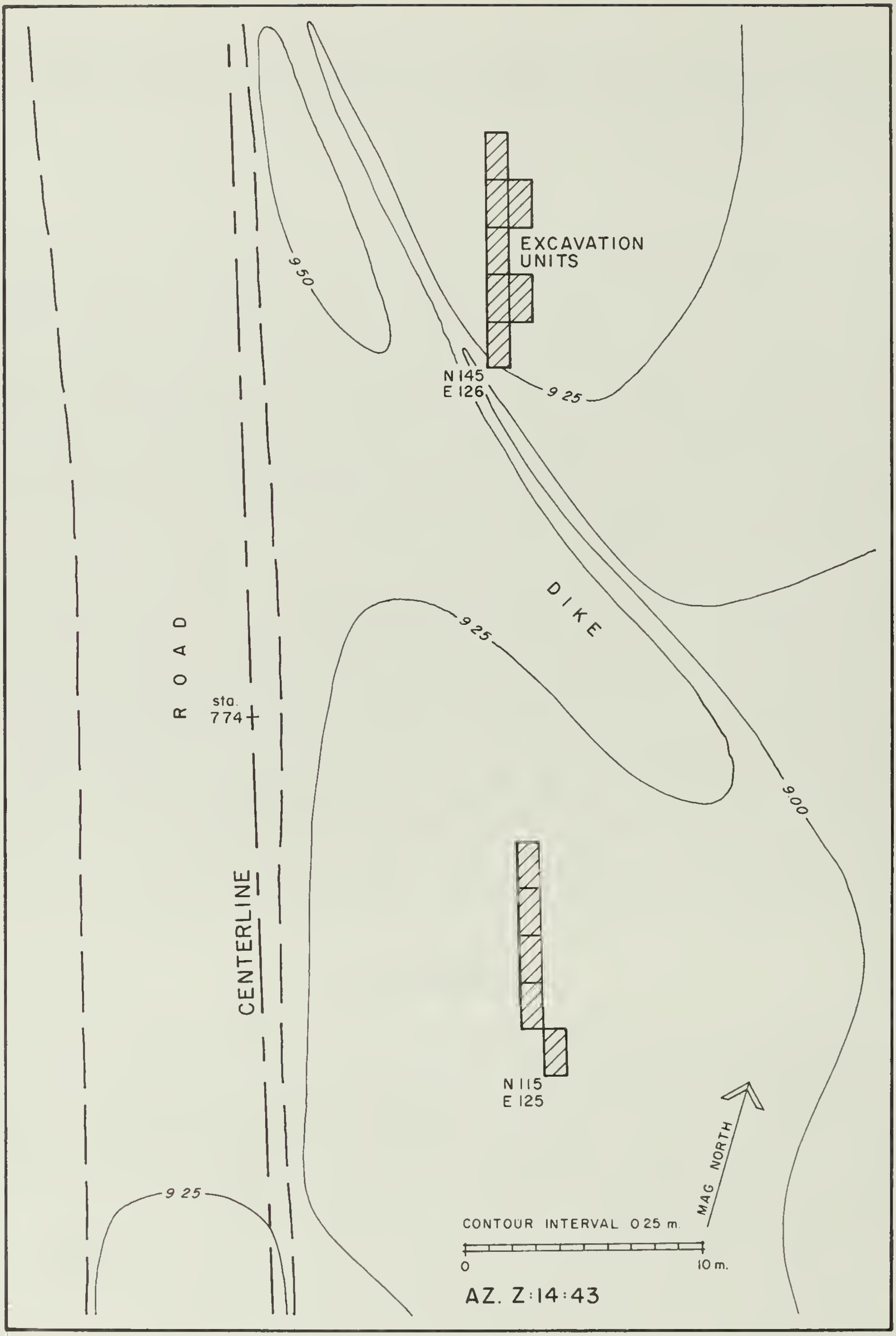


Figure 24. Map of Arizona Z:14:43.

TOTONI, Son.C:2:15

Setting

Sonora C:2:15 (Fig. 25) is located approximately 10 km (6.2 mi) south of the village of Gu Vo and 4.5 km (2.8 mi) northwest of Pia Oik along P.I.R. 1. The site is located at an elevation of 646 m (2,121 ft) on a long, low gravel terrace which diagonally crosses the north/south trending Barajita Valley. The land has a slight southeast tilt and is frequently cut by well-worn drainage systems. Long, well-rounded gravel fingers point away from the main wash, which runs along the western base of the Gu Vo Hills. Vegetation along these gravel fingers is predominately creosote and annual grasses, with mesquite present in the parallel drainages.

About 1.7 km (1.1 mi) south of the site area is a windmill with a few abandoned houses, the early 20th century village of Sweetwater. The abandoned older Papago well village of Siovi Shuatak (translation: Sweet water) is located 3.5 km (2.2 mi) southwest of the site area, across Siovi Shuatak Wash on the foothills of the Ajo Mountains.

Site

The site covered a large area, but our research was restricted to a 30 m (100 ft) wide right-of-way that extended for 130 m (400 ft) through the site. Cultural material was scattered over a large area outside the right-of-way. The low gravel ridges both to the north and south had materials similar to those found within the project zone. Light scatterings of material were likewise observed from the wash at the base of the Gu Vo Hills west for about 500 m (1640 ft). All of the material observed in the area was either ground or chipped stone, except for one spot where a Papago pot and some historic material of Anglo cultural origin had been dropped. Although no cultural features or structures were located in the research area, outside the right-of-way a few rock concentrations (probably hearths) were noted. Several cattle trails and two old vehicle

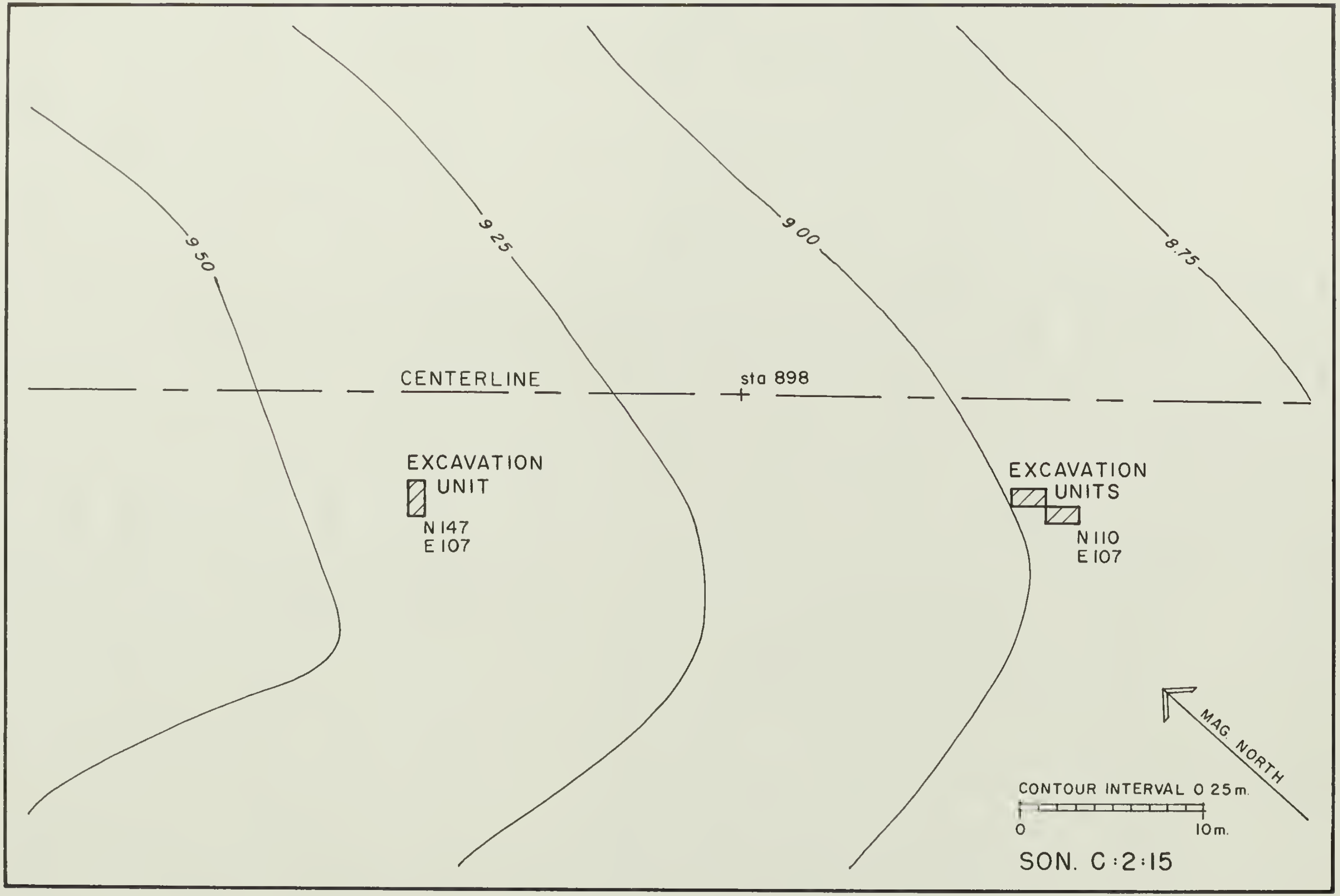


Figure 25. Map of Sonora C:2:15.

trails crossed the site; one ran east/west through Pia Oik Pass and the other ran north/south to Sweetwater.

Procedure

The area of the site affected by the right-of-way (30 x 130 m) was gridded into 5 m squares and surface collected. Two areas of moderate concentrations were noted, and three test pits (1 x 2 m) were excavated to a depth of 10 cm. A pick was used to break up the fill, a compact tan alluvium with considerable gravel and cobbles. Material return was almost nil in the three units; artifacts were found only in a shallow layer near the surface.

Interpretation

Investigation demonstrated that this site's cultural material is solely a surface manifestation. Given the known process of sheetwash, alluvial valley formation and the location and association of the cultural material on and with the gravel ridges, it is suspected that a certain amount of artifact movement has occurred. However, the grinding slabs, manos and a few hearths were not displaced.

More than one time period could be represented by the material. Except for the Pagago sherds and a little historic trash, all of the material recovered or seen was aceramic. Perhaps because this valley had a more plush environment prehistorically, hunting/gathering camp locations, such as this one, were frequently revisited.

MAIKU D, Son.C:2:20

Setting

Sonora C:2:20 is located along the southwestern edge of Pia Oik Valley, about 2.9 km (1.8 mi) south of the small village of Pia Oik. The

site, at an elevation of 582 m (1,910 ft), is situated near the blending of the colluvial slope and alluvial plain that extends from the eastern edge of the southernmost Gu Vo Hills. Small drainages come off the hillside, extend east past the site area for approximately 100 m and join a larger, south-trending wash which feeds into Pia Oik Wash. The drainage area supports thick mesquite growth. To the east are alluvial flats with a predominantly creosote cover. On the site itself the vegetation is creosote and bursage with frequent cholla and saguaro. Other vegetation surrounding the area are organpipe cactus, paloverde, ironwood, brittlebush and grasses.

Site

Research focused on this location because of a circular rock feature with a slightly depressed center (Fig. 26a). The outside dimensions of the feature were approximately 7 x 10 m with the center depression having a 3 m diameter. Virtually no cultural material was located on the surface surrounding the feature. The circle rose about .25 m above the surrounding area while the depressed center coincided with ground level. No evidence of burning was present on the soil surface.

Procedure

Prior to excavation, the vegetation on the feature was removed, the feature photographed and a 1 m grid constructed over the 7 x 10 m area (Fig. 26b). In lieu of a general surface collection, the feature was explored by digging three contiguous 1 x 2 m units along its southern boundary at 10 cm levels. The first three rows reached a depth of one level (Fig. 26c, d). A fourth row was further excavated and, at the third level, the rim of a burned circle was detected. This rim was entirely exposed before excavation in controlled levels was continued. Very few artifacts were recovered although the pit fill was screened. Radiocarbon and archeomagnetic samples were collected for dating (Appendices III, VII).

Interpretation

The feature functioned as a roasting pit. The pit extended 0.6 m below its detection level and had a thin (3 cm deep to 5 cm wide), burned earth border surrounding it. The pit diameter was 90 cm at the bottom and 145 cm at the top. Fill beneath the detection level in the center was a tan alluvium for about 15 cm until small rocks (5-15 cm diameter) were encountered. At about 40 cm an ash and charcoal level was reached, and rock size increased (15-25 cm diameter). In the bottom of the pit, rocks were even larger (25-40 cm diameter) and ash-covered. Beneath the rock level the fill changed dramatically to a compact tan alluvium with caliche. The rocks, ash and charcoal were located at the pit sides about 15-20 cm below the pit detection level.

An interpretation of the pit's construction can be formulated. A pit was dug, and the excavated dirt was piled around the perimeter (the mounded effect seen on the surface). Large rocks from the nearby slope were brought in and placed on the bottom to reflect and hold heat. A fire was constructed and covered by rocks, and then the object to be roasted was placed in the pit along with a few more rocks. Possibly fill was put on top, but the feature did not show this. When the food had been cooked the desired length of time, the upper rocks were lifted off, charcoal and ash were pushed to the side, the food was removed, and the pit deserted to be refilled by natural forces. A color change on the pit's bowl suggests a hot fire was used. However, because of a seeming lack of redisturbance and a scarcity of cultural material, it is also suspected that the pit represents only one event.

a. Feature with center depression.

b. After vegetation is removed and area gridded.

c. Roasting pit in cross-section.

d. Roasting pit after excavation.

Figure 26. Excavation of circular rock feature at Sonora C:2:20 exposes roasting pit.

GE AKI, Son.C:2:22

Setting

Sonora C:2:22 (Fig. 27) is located at an elevation of 585 m (1,920 ft) along the southern base of the Gu Vo Hills. Approximately 3.2 km (2 mi) north of the site along the eastern edge of the Gu Vo Hills is the village of Pia Oik. The site area is situated on an alluvial plain, extending south and east of the Gu Vo Hills. Drainage runs east-southeast into small washes, then drains into the Pia Oik Wash. These small washes are common and frequently cut into the long site area within the right-of-way; large washes are infrequent. An isolated hill stands approximately 500 m (547 yd) southeast, and beyond it extends the broad alluvial Quijotoa Valley. Across the site, the predominant vegetation is creosote with annual grasses, and bursage provides lower cover. Mesquite trees, as well as saguaro and cholla cacti, are frequent in the area.

Site

During the initial survey, an area 600 m (1,968 ft) long had been separated into three individual sites, but later testing indicated that they were all within one larger site. During excavation the general site area was walked to better understand the site. In the vicinity of Locus A, cultural material was restricted to a fairly small area. The closest material was about 200 m to the south, where a sherd and stone concentration covered an approximately 50 x 100 m area along a slight rise. However, this area was outside of the Project right-of-way by a considerable distance.

North of Locus A, material was scarce until Locus B was encountered approximately 300 m (984 ft) away. Cultural material found at Locus B was intermixed with a southeast/northwest trending band of surface gravel. The cultural material continued out of the road right-of-way but was confined fairly well to the width of the gravel (about 500 m or 1,640 ft).

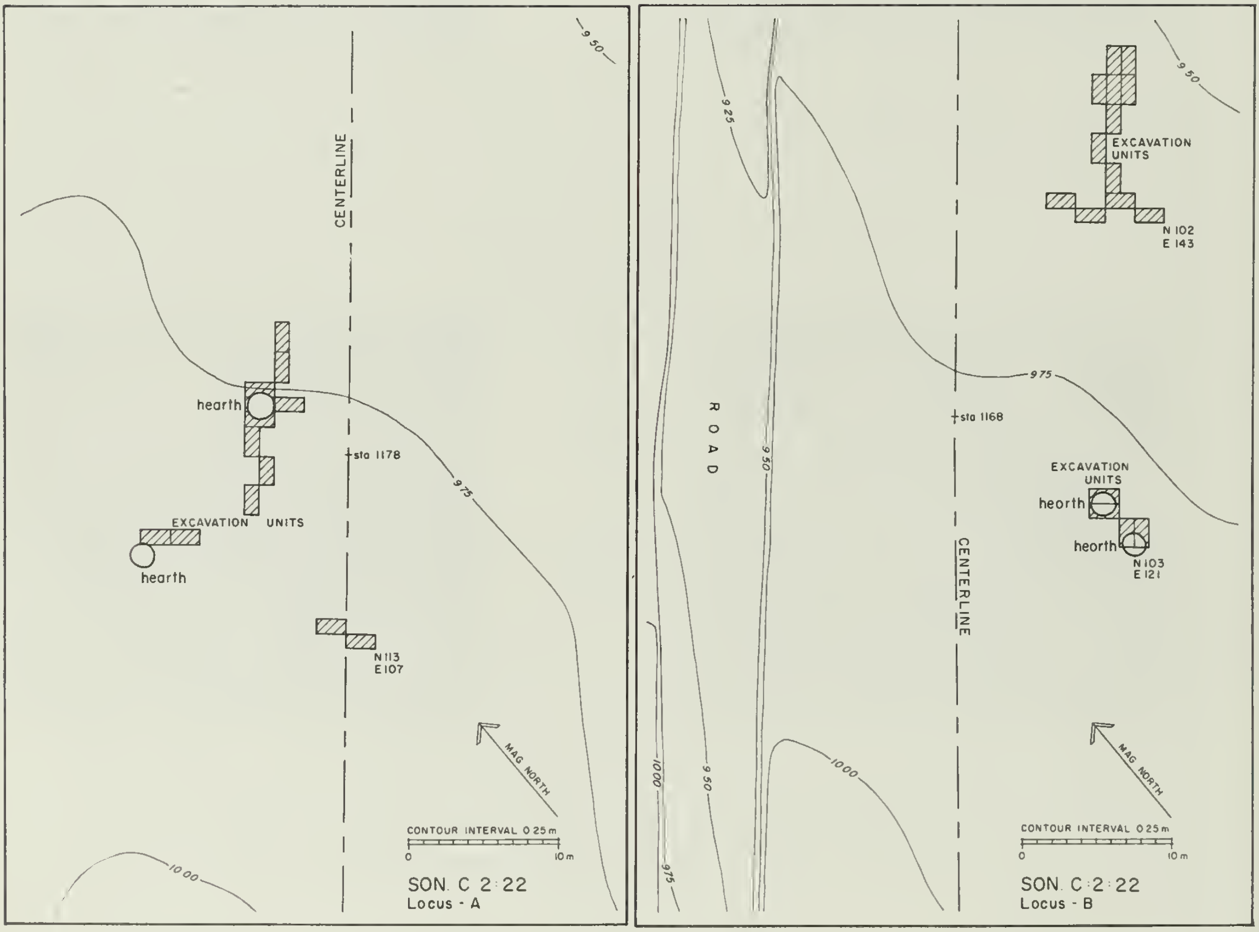


Figure 27. Map of Sonora C:2:22, Locus A and Locus B.

Procedure

Similar field methods were used at both loci. An area comprising all surface material within the right-of-way was gridded into 5 m squares and surface collected. Surface features (2 hearths at each loci) were mapped horizontally (Fig. 28). In and around these features, excavations were completed in 2 x 2 m units, in 10 cm levels, wherever concentrations of surface materials showed.

The area affected at Locus A was 30 x 40 m. Excavations were conducted at 2 hearths, in addition to a small concentration of material about 15 m from the hearths. The excavations were taken down to a depth of 20 cm, but very little was found in the second levels. Small charcoal flecks were sampled for dating at one hearth (Appendix V).

An area 25 x 60 m was investigated at Locus B, particularly around the two hearths and 20 m northeast of the hearths where a concentration of sherds and lithics indicated activities. The two surface hearths at this locus were cross-sectioned during excavation in an effort to better determine and understand their construction.

Radiocarbon samples of charcoal were likewise taken from one of the Locus B hearths. At concentrations test pits were dug almost all down to 20 cm, with very little being recovered in the second level. A small cluster of rock was located in the first level of one of the units. It lacked definition but was possibly a disturbed hearth since a few charcoal flecks were noted in the fill. However, its size and arrangement could not be determined due to earlier disturbances.

Figure 28. Surface feature, Sonora C:2:22.

Interpretation

The loci of this site may have similar functions but are from different time periods. Both have two surface hearth features of similar size and construction, circular clusters (1.5 to 2.5 m in diameter) of stone cobbles that extend 5 to 8 cm beneath the surface. There was no increase of artifacts around them. Because of the local exploitable vegetation and lack of village-like features or artifacts, these sites, along with Sonora C:2:23, may be interpreted as gathering/processing camps.

ALI CHUK 38, Son.C:2:23

Setting

Sonora C:2:23 is situated at the northern end of a broad alluvial plain, the La Quituni Valley, just south of the lower end of the Gu Vo Hills and about 4.8 km (3 mi) south of the present village of Pia Oik. The area drains to the southeast into Pia Oik Wash, which empties into Menagers Lake 9.6 km (6 mi) further south. No drainages cross the site itself; the nearest small wash is approximately 100 m to the south. Vegetation on the site is sparse, consisting of bursage and some creosote. In the surrounding area are mesquite, cholla and saguaro; a few paloverdes grow near distant washes. About 25 m southeast of the site is an area, 75 by 200 m, developing desert pavement.

Site

The only feature at this location was a hearth, measuring 2 m in diameter and associated with a light scatter of lithic debris and cores. Since there was a negligible amount of cultural material on the ground around the rock cluster, no surface collection was made prior to excavation; instead, the hearth was photographed and a plan sketched.

Only five (1 x 2 m) units were excavated around and through the rock cluster. These units were all two levels deep (20 cm), although no material was recovered below 10 cm. As usual, all excavated fill was sifted through a one-quarter inch mesh. Only lithic material was recovered: flakes, cores and ground stone.

The feature appeared to be a surface rock cluster with no excavated pit. The artifact yield in and around the hearth was very low. A radiocarbon sample was attempted from small bits of charcoal dispersed among the rocks but not enough was collected for a reliable analysis. The fill of the hearth was the same dark gray, ashy alluvium; it extended to a depth of between 6 and 10 cm. Away from the hearth, the top 6 to 10 cm

were the local tannish alluvium. Underneath the fill, a sterile, naturally reddish clay was encountered throughout the excavated area. No other cultural features were located in the excavations.

Interpretation

The feature is probably an isolated hearth. Lithic material recovered in excavations gives the impression that this was a temporary campsite, possibly used for either an aceramic function or by people who broke no pottery during their stay here.

AL JEG, Son.C:2:25

Setting

Sonora C:2:25 (Fig. 29) is located in the southwest corner of the Papago Indian Reservation along the southeastern edge of the Cerritos de la Angostura, approximately 1.2 km (.75 mi) north of the present village of Ali Chuk. To the south and west of the site area a wash drains the southwestern corner of Ali Chuk Valley into Ali Chuk Wash. The site itself sits on a small knoll above the drainage.

In the site area, the vegetation is mainly creosote and bursage with a few ironwood trees, saguaro and cholla cacti nearby. The wash has a prolific stand of mesquite and paloverde. Northeast and upslope, towards the Cerritos de la Angostura, there is a dramatic increase in saguaro with a few stands of organpipe cactus.

Site

The site covered only a small area (15 x 40 m). Intensive surface collections were carried out, and excavations were limited to an 4 x 8 m area within the collection area at surface material concentrations. Just

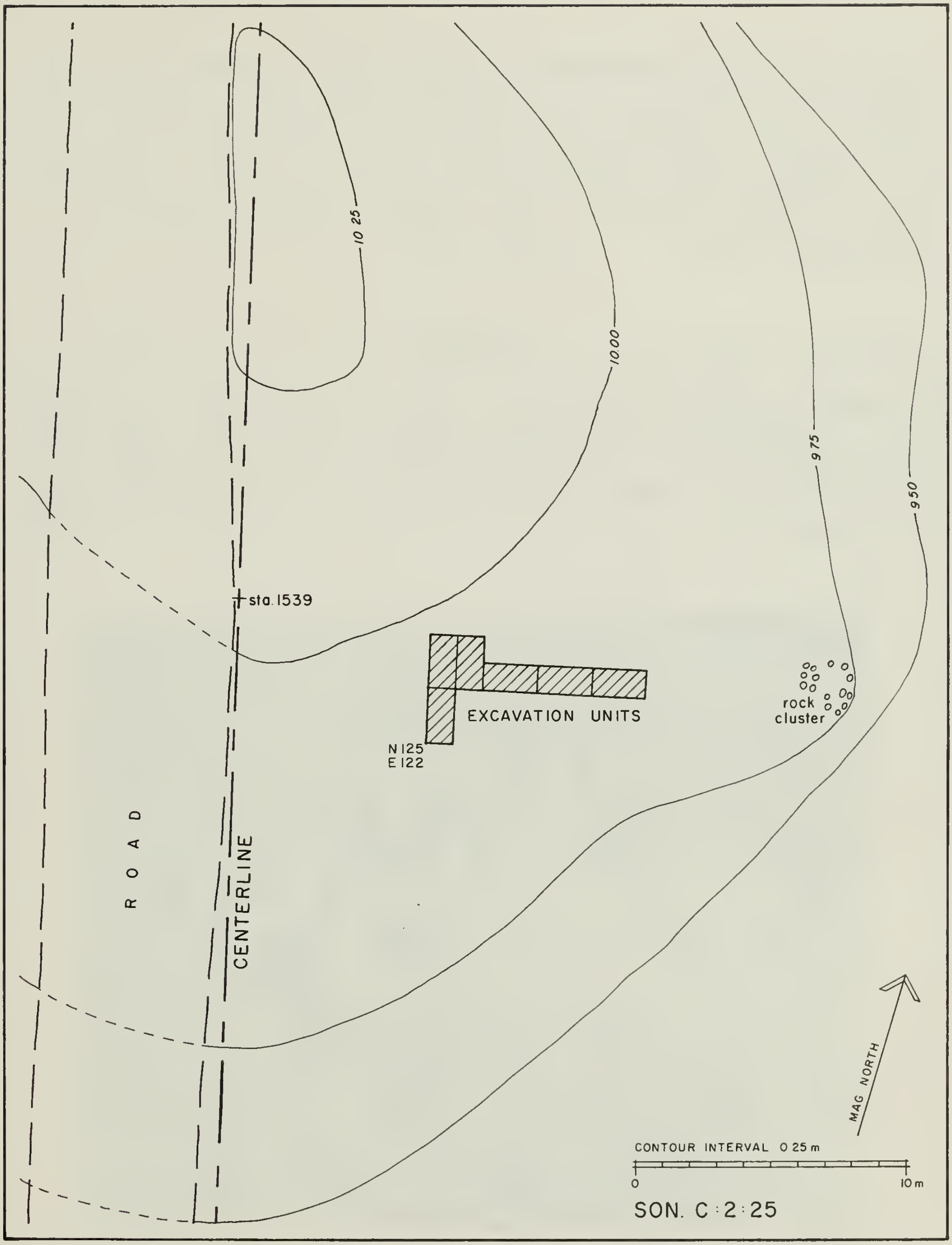


Figure 29. Map of Sonora C:2:25.

outside of the road right-of-way, a small, shallow, rock-lined pit was recorded and photographed but not disturbed (Fig. 30). A second possible hearth was also located, again outside of the project area. Even though lithic debris was noted downslope, especially to the east, neither features nor concentrations that might indicate extensive camping or a village were located.

Procedure

Field procedures here were the same as at other sites. A 15 x 40 m area was gridded in 5 m units for surface collecting. All culturally related material in these units was collected. A lithic/ceramic concentration was noted. Smaller test pits were dug to facilitate excavation;

Figure 30. A small rock cluster at Sonora C:2:25.

these were expanded in the direction of greatest returns. No structures or features were located in the squares. The area in the right-of-way nearest the above-mentioned rock-lined pit was excavated without definite results since recovered material neither increased or decreased.

Interpretation

Southwest of the site is a flat area which could have been used in floodwater farming, but areal exploitation is more likely. The location, vegetational surroundings, material culture and features give the impression of plant processing activities, possibly for fruits of saguaro and organpipe cactus.

ARTIFACTUAL MATERIAL

Although fieldwork at individual sites sampled only a small percentage of the total area, a great deal of artifactual material was recovered. Over 52,000 pieces of pottery, stone, shell and bone were analyzed during laboratory research. Since this data constituted our primary information on aboriginal culture (features and structures were miminal), research designs were developed for each artifact category. Detailed discussions of ceramics, chipped and ground stone and shell follow.

Summarizing the previous archeological work accomplished in the Papagueria, Haury (1950:3) mentions two reasons for the absence of investigations:

> . . . the country presented certain difficulties in transportation and . . . (there was) a general feeling that the archeological resources of the area were extremely limited.

The P.I.R. Project alleviated the transportation problem and did not substantiate the dearth of archeological resources. Intrigued by the mixed results of previous investigations, we faced our analysis with interest; there was much confusion about cultural traditions, and little fieldwork had previously been undertaken in the Quijotoa Valley.

Table 3 AMOUNTS OF ARTIFACTS AT MAJOR LOCI

Site	Shell	Bone	Debitage*	Chipped Tools	Cores	Ground Stone	Plain-wares	TOTAL
Az.Z:14:21a	12	0	12	9	0	1	262	296
Az.Z:12:21b	117	12	33	2	2	6	56	228
Az.Z:14:21c	400	976	3,752	195	40	20	13,058	18,441
Az.Z:14:28a	74	13	70	10	3	5	915	1,090
Az.Z:14:28b	12	8	188	4	7	14	796	1,029
Az.Z:14:30	73	106	1,210	35	20	29	1,619	3,092
Az.Z:14:32	20	3	4,987	454	211	90	484	6,282
Az.Z:14:33a	682	552	4,704	244	160	82	5,914	12,338
Az.Z:14:33b	4	0	556	37	42	26	0	665
Az.Z:14:33c	3	0	740	200	64	46	56	1,109
Az.Z:14:43	4	0	240	27	15	12	1,155	1,453
Son.C:2:15	0	0	842	100	61	4	0	1,007
Son.C:2:22a	5	0	226	7	8	4	28	278
Son.C:2:22b	1	0	299	24	32	20	0	376
Son.C:2:25	5	0	77	11	9	4	92	198
Az.Z:11:5	39	388	136	30	3	12	3,521	4,129
Artifact Totals	1,451	2,091	18,072	1,389	677	375	27,956	52,011

*Minus Cores

Redwares and decorated sherds are not included. See Table 7.

CERAMICS

By

Marc B. Severson

The pottery recovered along P.I.R. 1 and P.I.R. 34 during the Quijotoa Valley Project represents an indigenous tradition of vessel manufacture from local igneous clays. Over 30,000 potsherds from 41 sites were analyzed in the laboratory; less than 2 percent of these were decorated or slipped wares. Several partially restorable vessels were also found. The evidence supports Ezell's hypothesis that most Papaguerian ceramic sites have pottery belonging to the "Sonoran Brownware Tradition." Our sample did not contain a high percentage of intrusive types. Notably, only Az.Z:14:32, Az.Z:14:42 and Az.Z:11:5 possessed adequate collections. In this manuscript the pottery types, their attributes, uses and cultural affiliation are discussed.

Previous Investigations

Previous investigations tentatively established a ceramic chronology for the Papagueria (Table 4). Wither's (1973) fieldwork at Valshni Village defined Papaguerian ceramics as a three phase, chronological, sequenced, indigenous red-on-brown tradition. The first phase, called Vamori, is indicated by the presence of Vamori Red-on-brown, Valshni Red and Sells Plain. Vamori Red-on-brown is primarily an uncomplicated decorated brownware with design elements that are quite similar to those of Yuman wares. The second phase is Topawa. An exceedingly small sample of Topawa Red-on-brown was found at Valshni, but with the addition of a few sherds from Punta de Agua (Greenleaf 1975a) and another site south of Valshni, Topawa enjoys a somewhat sounder reputation than does Vamori, identified at only one site. Still, as described, it is little more than a specialized variety of the later Tanque Verde Red-on-brown, its lineal descendant. The third phase, the one to which most of the Quijotoa Project sites belong, is the Sells phase. It is indicated by Tanque Verde Red-on-brown, Sells Red and Sells Plain.

In each of the phases represented at Valshni, different decorated wares predominate. At the beginning of Valshni's history, decorated ceramics are dominated by the Hohokam Red-on-buff series, evolving until A.D. 1000. Local Red-on-brown and Trincheras wares form 40% of the decorated pottery, while buffwares comprise 60%. By A.D. 1200 Tanque Verde Red-on-brown dominated the intrusive buffwares and Trincheras wares (Withers 1973: 49). The Valshni site's ceramics seem to parallel the evolution in ceramics that occurred over the entire Papagueria in the Classic period.

In contrast to Valshni Village, Jackrabbit Ruin ceramic remains are all Sells phase material (Scantling 1940). More, therefore, is known about this late prehistoric occupation than about previous periods. The intrusive sherds of Jackrabbit Ruin shift focus from Valshni. Twenty sherds of Casa Grande Red-on-buff and five sherds of Gila Polychrome indicate Gila-Salt Basin contacts. No Trincheras wares were noted, perhaps due to the late (Classic) date of occupation.

Table 4

CERAMIC CHRONOLOGY

PERIOD		GILA-PHASES (Haury 1976; Doyel 1974)	TUCSON-PHASES (Greenleaf 1975a; Stacy & Hayden 1975)	PAPAGUERIA-PHASES (Haury 1950)	QUIJOTOA VALLEY
	300 B.C.	Vahki	Vahki		
	A.D. 100	Estrella	Estrella		
PIONEER	A.D. 300	Sweetwater	Sweetwater	?	
	A.D. 400	Snaketown	Snaketown		
	A.D. 600	Gila Butte	Canada Del Oro		
COLONIAL	A.D. 700	Santa Cruz			?
			Rillito	Vamori	
	A.D. 900	Sacaton			Topawa
SEDENTARY			Rincon	Topawa	
		Santan ?			
	A.D. 1100				Sells
	A.D. 1150	Soho	Cortaro Tanque Verde		
CLASSIC				Sells	
	A.D. 1400	Civano	Tucson		

Haury's (1950) excavations at Ventana Cave confirmed the Classic period chronology established by Withers and Scantling. Subsequent areal surveys, however, raised questions about ceramics in the southern and western Papagueria. Ezell's 1952 survey of the Organ Pipe Cactus National Monument noted the presence of Yuman wares as well as brownwares within the Papagueria. He described (Ezell 1955) the indigenous pottery as the Sonoran Brownware Tradition.

Fontana'a (1965) Cabeza Prieta survey also encountered differing ceramic traditions: Hohokam, Yuman and Historic. His earlier discussion of historic and modern Papago pottery is one of the few works of its kind available to researchers (Fontana and others 1962). Hayden's Pinacate survey (1967) discussed the relationships between Yuman, Pinacatenan and Sand Papago pottery. Likewise, he noted the use of Yuman ceramics at Papago sites.

Research Design

"Tradition," the evolving methods of pottery manufacture unique to a regional or cultural group, is a major focus of ceramic analysis. The concept of the Gila Basin's Buffware Tradition is well established and includes various Hohokam Red-on-buff wares, Gila Plain and perhaps Wingfield Plain (Gladwin and Gladwin 1929a). The later Salado Tradition, including Gila, Tonto and Pinto Polychromes, Gila and Salt Red and associated wares like San Carlos Red, San Carlos Red-on-brown, Roosevelt and Tularosa Black-on-white, Salado Red and Tonto Corrugated has also been identified (Steen and others 1962; Windmiller 1973a). The Lower Colorado Buffwares, while little understood, are likewise easily recognized as a separate tradition of pottery manufacture (Rogers 1945a). Ezell (1954: 16) clearly presented his idea of the Sonoran Brownware Tradition of the Papagueria. We hoped our research would support his statement, specifically answering four questions:

1. What is the difference between Gila Plain of the Buffware Tradition and Sells Plain of the Sonoran Brownware Tradition?
2. What variety exists within plainware types? (Thus clarifying the type description of each.)
3. What variation exists within Sells Plain after sorting out Wingfield and Gila Plain?
4. Were decorated wares locally manufactured or not?

If these ideas could be verified, then our information would support Ezell's concept of a Sonoran Brownware Tradition.

When analysis was begun, several interesting peculiarities were noted. Most of the sherds from the various sites were exceedingly small, weighing an average of 3 g each. There was also a low proportion of redware or decorated wares compared to plainwares, although the small amount of decorated ware was less startling than the scarcity of redware. Both Scantling (1940) and Withers (1941) had found large amounts of redwares at Jackrabbit Ruin and Valshni from the late Sedentary through the Classic periods. Kelly (n.d.) found the same situation at the Hodges Site. Our paucity of redwares and decorated wares was hypothesized to indicate that they might not be indigenous to our area, or that only plainwares were made at Quijotoa Valley floor sites, while decorated and redwares were made at hill villages or at settlements to the east, perhaps in the Baboquivari Valley.

Methods

The ceramics were initially separated by rims, redwares, decorated sherds, worked sherds and any oddities. The remaining plainware body sherds were further subdivided into the categories listed in the ceramic code (Table 5), created to describe the variation within our plainware sample. An explanation of the ceramic categories and their attributes follows.

Table 5 PLAINWARE CERAMIC CODE

Code Number	Description	Surface	Comments	Categories
00	eroded			
10	sand	unfinished		
11			smudged	10-43, 81, 85
12		smoothed		and 86 are Sells
13			smudged	Plain
14		polished		
15			smudged	
16		burnished		
17			smudged	
18		micaceous		
19		scummed		
20	basalt	unfinished		
21			smudged	
22		polished		
23			smudged	
30	slate	unfinished		
31		polished		
40	schist	unfinished		
41			smudged	
42		polished		
43			smudged	
50	Gila Plain	unfinished		
51			smudged	
52		polished		
53			smudged	
60	Wingfield (schist)			
61	rhyolite (vast tempered)			
70	buff paste			
71		polished		
80	unidentified			
81	stucco			
82	buff (Gila paste)			
83	Orangeware			
84		scummed		
85	crushed quartz			
86	stained andesite			
88	Colorado Buff			
89		polished		
90		scummed		
	Additions			
-1	smudged			
-2	polished			
-3	carbon core			
-4	interior			
-5	exterior			
-6	incised			

Ceramic Code Descriptions: Plainware

Sand Tempered Sells Plain - Sand tempered refers primarily to residual (or igneous) clays which have sand as a native inclusion or as an addition by the potter, neither of which is uncommon for Sonoran brownwares. Close examination of pottery surfaces in the laboratory to determine their distinguishable characteristics showed plainwares, especially sand-tempered wares, display a variety of finishes. The code distinguishes each.

"Eroded" sherds are those sand tempered wares which have lost their surfaces, so their finishes cannot be identified. "Unfinished" means no finish was applied to the surface, and, in this study, includes surfaces that showed some smoothing. Only if the smoothing were well executed and consistent in texture over the whole of at least one surface was it considered sand smoothed.

Polishing is a much more easily recognized finish. A considerable percentage of the plainwares were polished. Generally, polishing tends to darken the clay's color (Shepard 1956). Streak polishing is easily recognized, not only by spaced striae, but also by alternate light and dark bands distinguishing unfinished from compacted clay. Use polish occurs accidentally and can often be recognized by the lack of uniformity in the direction of the striae and by their shorter lengths.

Burnishing, as a finish category, indicates a high gloss polish. This is a subjective distinction from simple polishing but is included because it appears infrequently in the sample. Gerald (1951) noted that the burnishing on Papago Red differed from the easily recognized striations on Sells Red.

Smudging is a common decorative and functional device. Since it is often combined with other finishes, it is included under comments in our code.

The categories micaceous and scummed sand were appended to the ceramic code. Micaceous refers to brownware with copious amounts of mica added to the paste. This variety was distinguished from Gila Plain by its lack of certain characteristic features. (See Gila Plain below.) "Sand scummed"

refers to salt impurity in the clay which percolates to the surface (normally interior) during drying and/or firing. It may appear to be a thin slip, but Hayden's (1976: personal communication) experiments suggest it is probably a primitive alkali glaze.

Three more varieties in the code pertain to Sand Tempered (Sells Plain) wares. They represent two native basalt and slate inclusions and a specialized schist addition to the clay. Sand with basalt is characterized by small, rounded, vesicular basalt fragments along with rounded sand. Either sand with basalt was added for temper to the clay, or these were naturally occurring inclusions. The same conclusion cannot necessarily be drawn about the more abundant slate-like inclusion, which ranges between 5% and 40% of the mass. It is possible that the slate is a natural inclusion, but it is less obvious than in the case of the basalt.

Sand with schist differs from Wingfield Plain in the code. Normally, this is a highly micaceous schist in angular fragments, indicating it was probably added to the clay rather than being a naturally occurring inclusion. Some of the sherds appeared to contain only a fortuitous fragment or two of schist; in other examples, the schist comprised as much as 50% of the mass.

Gila Plain - Gila Plain (Gladwin and others 1937) was mostly from Az.Z:11:5 where portions of several large vessels were recovered. It is well made and is probably the best constructed plainware in the sample.

Rhyolite (vast temper) - Vast temper mass is a term employed to differentiate a rhyolite tempered brownware from the Hohokam Wingfield Plain. Ezell (1954) described this ware as having a decidedly purplish cast but did not identify the causative tempering material.

Buffwares - Buff paste refers to plainware sedimentary clay whose origin is hypothesized as either Yuman or Hohokam. Although it is thought that most of these sherds were of the former tradition, they lacked the

characteristic scum. Gila-Salt buff is the undecorated form of Hohokam buffwares and is classified separately.

Miscellaneous - The last divisions of the ceramics code present limited distinctions in our sample. The unidentified category included those few sherds not distinguishable as to type or tradition. Stucco ware (Fig. 31a) was rare and seemingly not of Colorado River origin, but probably Yuman influenced. Likewise orange firing sherds found at southern sites also may be Yuman associated. The orange is only a thin surface color over a light gray core. These sherds are often scummed on one or both surfaces.

Two additional divisions of Sells Plain were noticed late in the study: (1) crushed quartz, probably added in lieu of sand as a natural inclusion and (2) ground clay used as a sherd temper. Both comprised a very small sample of sherds weighing only a few grams.

Yuman plainwares were recorded as Colorado Buff. No Yuman brownwares were seen. Because they tend to be rather distinctive, it was felt that none were incorrectly separated into Sells Plain during analysis. The Yuman buffwares were differentiated as either unfinished, polished or scummed. Finally, six finish details were added to the code to accommodate specifics such as those found on Papago Plain: smudged, polished, carbon core, interior, exterior and incised.

Ceramic Code Descriptions: Redware, Decorated Ware, Rims and Worked Sherds

Detailed analyses were carried out on these categories listing the attributes of each sherd (Table 6). For the purpose of ceramic analysis, provenience codes were created; a letter indicated the site and the three last digits indicated the precise provenience within that site. Thus Huihikiwani (Az.Z:11:5) excavation unit North 160 East 205 Level 2, which would be written Hick N160 E205 II, became H052. Due to the limited specimens for each of the above analyses, each one was given a number for further identification, if necessary.

Table 6 SPECIALIZED CERAMIC CODE

A. REDWARE ANALYSIS - Huihikiwani

Prov.	No.	Type	C*	Vessel	Slip	Polish	Comments
026	021	Gila Red	bl.*	bowl	int.ext.*	int. ext.	exterior fire clouding
142	022	Sells Red	br.*	bowl	interior	int. ext.	mica added

B. DECORATED WARE ANALYSIS - Huihikiwani

Prov.	No.	Type	Vessel	Slip	Polish	Field	Comments
071	001	Snaketown R/B*	jar	--	ext.	ext.	hatched broad bands w/sawtooth edge
068	002	Tanque Verde R/B	bowl	--	int.ext.	int.ext.	diagonal bands of parallel lines

C. RIM ANALYSIS - Huihikiwani

Prov.	No.	Type	Vessel	Orifice	Comments
017	022	Gila Plain	seed jar	---	elliptic rim
381	023	Sells Plain	wide mouth jar	17 cm	rounded rim, short neck

D. WORKED SHERDS - all sites

Prov.	No.	Type	Shape	Method	Perforated	Comments
050	C412	Sells Plain	round	broken & ground	biconical	spindle whorl
051	H321	Tanque Verde R/B	ovoid	broken	--	

*C = Core color; bl = black; br = brown; R/B = red-on-brown; int.ext. = interior,exterior.

Redwares - Redwares were recorded by the following variables: type, core color, vessel form, slip location (interior, exterior or both) and polishing (interior, exterior or both). Any additional data was noted under the heading for comments, such as the presence or absence of mica, erosion of the slip and so on.

Decorated - Decorated wares were recorded by type, vessel form, slip, polish, field layout and other characteristics.

Rims - Rims were noted by type, vessel form, and orifice radius. Only on the rim analysis sheet (Table 6) was any effort made to specifically identify the vessel form for example, high neck jar, flare rim bowl.

Worked sherds - Worked sherds were recorded by approximate shape, including general dimensions, method of working (shattering use, breaking, grinding), perforated or not and other comments.

Quantification

After the units were separated into categories and coded, they were weighed and counted by provenience (Table 7) except for the redwares and decorated wares. These formed such a small sample of the entire collection that it is felt their provenience has little significance within sites and becomes important only in site comparisons.

From this data several hypotheses were tested. Despite the work of Wasley and Johnson (1965), we felt that there would be a difference in the ratio of weight to number which would more adequately represent our sample, if not within the plainwares, then among the plainwares, redwares and decorated types. We also thought there might be some standard weight we could establish for accurately estimating the number of sherds without the tedium of counting. As it turned out, standardization of weights was not possible since sherd size is affected by both the nature of deposition of the material and subsequent movement and breakage. The plainware body

Table 7 SHERD TABULATIONS Weight(g)/Number

SITES

TYPE	Az:Z:14:21A	14:21B	14:21C	14:23	14:28A	14:28B	14:30	14:31
Sells Plain	689/258	275/55	41,894/13,721	3,017/1,601	5,698/884	1,357/918	7,121/1,593	374/93
Basalt			672/162					
Slate	12/4		4/1		110/22	31/12	357/75	0/2
Schist			378/69		18/7	6/1	6/1	
Gila Plain			461/114		12/2	26/4	26/4	
Rhyolite					67/15			
Scum					8/1	14/3		
Others		55/1	106/10		127/10			
Colorado Buff					6/1	24/6		
Sells Red					115/22	352/82		
Tanque Verde	24/4		152/17		126/17	194/33		
Valshni Red			113/21		13/3			
Rincon R/br			179/18		0/2			
Gila Red			26/2		40/4			
Papago				246/82				
Other Reds			230/107		90/37	35/11		
TOTALS	725/266	330/56	44,215/14,242	3,263/1,683	6,430/1,027	3,039/1,070	7,510/1,673	374/95

SHERD TABULATIONS: Continued Weight(g)/Number

SITES

TYPE	Az:Z:14:32	14:33A	14:33C	14:43	SonC:2:22	2:25	Miscl.	Az:Z:11:5
Sells Plain	211/43	31,832/5,913	199/56	205/82	50/16	134/88	519/84	13,960/3,008
Basalt								
Slate	4/2	335/57				38/2	1/1	37/13
Schist	68/19	244/23	5/1		6/2		40/12	85/8
Gila Plain		72/13						2,785/546
Rhyolite	30/5	9/1					55/6	
Scum	50/21				44/12		110/19	
Others	191/134					17/2		54/26
Colorado Buff	552/222			1,561/1,088			7/2	
Sells Red		1,341/238				5/1	21/4	694/103
Tanque Verde		1,231/105						405/70
Valshni Red								
Rincon R/br								
Gila Red		114/40						81/20
Papago		159/8					800/60	13/1
Other Red		494/140						452/221
TOTALS	1,106/457	35,831/6,538	204/57	1,766/1,070	100/30	194/93	1,553/188	18,566/4,016

sherds from our sites were particularly fragmented, weighing an average of three grams.

A significant trend in weighing sherds rather than counting them did appear when we weighed the redwares and decorated sherds. Generally, the redware sherds weighed about four grams each, and the decorated wares averaged close to six grams each. This indicated that the weight of equal numbers of sherds of plainwares, redwares and decorated wares represent inverse proportions compared with the actual number collected of each. This inverse relationship may result from greater care in preparing redwares and decorated wares, since these were less fragmented.

As a further hypothesis we felt that the difference between sedimentary clays (buffware) and igneous clays (brownware) would be apparent in the densities and average weights. Density analysis of each variety was attempted (Appendix X) but proved inconclusive. Consequently, weights were taken as adequate without correction or standardization.

Type Descriptions

While the ceramic types discussed in this report have been presented elsewhere, our descriptions clarify how the types have been identified in this particular study.

Sonoran Brownware Tradition

Sells Red, Sells Plain and Tanque Verde Red-on-brown are the main types of the Sonoran Brownware Tradition discovered at Project sites. The unifying feature of Sonoran Brownwares is the use of clays derived from igneous rocks weathering and laid in beds (Shepard 1956). A granitic rock may produce a clay containing feldspar, quartz and mica, while a volcanic rock may contain minerals such as basalt and hematite as natural inclusions. In addition, during the deposition of the clay in beds, sand carried by water becomes intermixed, often producing a "self-tempered" clay. Clays are usually found when their beds are cut by washes. Since sand is

a common inclusion in these clays, it is generally found in the pottery itself.

Manufacture

It is possible that certain beds produce clays more suited than others to decorated ware manufacture while other beds produce clays more suited to plainware. The actual process of producing a vessel undoubtedly includes different idiosyncrasies from potter to potter, but several constants of technique are indicated in our sample. After the clay is crushed, large inclusions still remaining are picked out (the task of removing large nonplastic inclusions continues throughout the manufacturing process), then the clay is wetted with what is ethnographically a universal unit of measure, i.e., "just enough water." The clay is probably left to "sour" at least overnight and perhaps longer, as there is a direct relationship between plasticity and ease of molding and the duration of time clay is allowed to cure (Rogers 1936; Fontana and others 1962; Shepard 1956).

Shepard (1956) states that "grog" or a nonplastic material (often termed "temper") is occasionally added to clays to prevent cracking during drying. Laboratory observations suggest that coarse platelets of rock may temper the vessel's porosity by establishing rugged edges to which the clay particles adhere, while at the same time leaving large flat surfaces that can be aligned with the vessel's surface by finishing. Apparently, with many of the brownware clays, no "grog" was needed due to the natural inclusion, as indicated by the rounded fragments in the paste. In other cases different types of "grog" were added to the natural inclusions. Schist, mica, rhyolite and slate are all fairly common in the Papagueria; sand occasionally occurs as temper.

A typical firing may have included the following sequence. Decorated vessels and/or redwares were placed in the center of a pit on top of sherds to prevent them from contacting the fuel, then plainwares were laid around this core and the outside fuel laid against these vessels. Some fuel may have been placed directly against individual pieces to produce

patterned fireclouds. If no decorated or redware pots were to be fired, less care was probably taken in layering. Conversely, if only painted and/or slipped wares were involved, more sherds may have been employed in an attempt to either prevent or specifically direct contact with the fuel.

It appears in this Sonoran Brownware Tradition that the care involved in firing was directly proportional to the value of the piece; for example, when redwares are fire-clouded or interior smudged, or when decorated wares have a smoke-darkened field (producing a red-on-gray or black) these techniques are likely to be intentional (Hawley 1930b; Sauer and Brand 1931). In contrast, on plainwares the same effects apparently are accidental occurrences.

Primary areas of brownware production include the Tucson Basin, from the Rincons west to the Tucson Mountains and from the Tortolitas south beyond the Santa Ritas (Severson 1974); the Papagueria, from the Roskruges-Baboquivaris west to the Growler Range and from the Gila south to the Altar (Lumholtz 1912); and the Altar drainage, east of the Sonoran portion of the Pinacate, south of the Tucson Basin and bordered by the Rio Magdelena to the south and east (Johnson 1960).

Besides covering a wide area geographically, brownware manufacture appears to span a long time (Table 4). As Kelly (n.d.) defined the sequence, local ceramics in the Tucson Basin began in the Canada del Oro phase (Colonial period comparable to Gila Butte at Snaketown) around A.D. 500 and have continued up to the present with the Papago wares.

Sells Plain

First described by Scantling (1940) at Jackrabbit Ruin, Sells Plain represents the primary culinary and storage ware of the Sonoran Brownware Tradition. The history of Sells Plain closely follows that of Gila Plain from the Canada del Oro phase of the Pioneer period through the Classic period. Its range includes the entire Papagueria as well as the Tucson Basin and perhaps the Altar drainage. The limits of the distribution of Sells Plain may extend to the Growler Mountains and Rio Sonoita in the

west, the Rio Altar in the south, the San Pedro River in the east and nearly to the Gila River in the north.

Several other residual brownware pottery types have been named in this area. Danson (1957: 229) noted Gila Plain-Tucson variety as being the indigenous plainware of University Indian Ruin. However, the type he described closely resembles Sells Plain in its characteristics. It is possible that the original plainware of the Tucson Basin more closely resembled Gila Plain during the Pioneer or Colonial periods but began to be less influenced as ceramic techniques developed. DiPeso (1953) described two ceramic types at San Cayetano, sorted primarily on whether or not the vessel was polished. Again, as with the Tucson variety of Gila Plain, by description, DiPeso's Ramanote and Paloparado Plain could just as easily be Sells Plain.

Greenleaf (1975a) noted such divergence in his plainwares that he was unable to type them. His quandary may have been caused by having three type names applied to the same description from other expeditions in the vicinity, any of which could be expected to occur at Punta de Agua. It is for precisely this reason that in this report all the sand-tempered plain brownware variations from the Sonoran Brownware Tradition are categorized as Sells Plain.

<u>Paste</u> - Various natural inclusions have been noted in our sample, including mica, basalt, schist, rhyolite and slate. If not present naturally, mica and a mica-schist, less often quartz, and possibly slate and rhyolite have been crushed and added to the paste. While other traditions were very specific as to what material is to be added, for Sells Plain "grog" or temper may be as much a matter of convenience as habit.

During initial crushing of the clay, the potter can begin to tell if additional nonplastic material is needed to prevent cracking. Ethnographic study indicates the clay was dug from a pit and crushed on the spot with a club or heavy branch (Fontana and others 1962). Evidence from our sample for prehistoric existence of this practice is perhaps indicated

by pockets of carbon residue from small bits of organic material (bark and wood splinters?) commonly appearing in our sherds.

Laboratory experiments indicate that most of the wares seem to have been fired below 700° C and that the Sells Plain was fired at the lowest temperature (Appendix IX). The amount of vitrification is slight, resulting in the crumbling fracture of these wares. The amount of nonplastic inclusions may also contribute to their crumbling nature, since a higher ratio of nonplastics to plastics occurs in these clays.

Despite the effort of crushing the clay, the low firing heat and the large amount of nonplastic inclusions produce a generally coarse-textured paste. Incomplete oxidation of the carbonaceous material within the clay mass, combined with carbon from the fire, darkens the surface and core. Thus the actual clay color rarely shows. Gray to dark brown with areas of buff to brown or red normally occur in Sells Plain vessels.

Manufacture - After the clay was cured, as described previously, construction was probably begun by molding a base. Twenty-seven Sells Plain sherds in our sample indicate the original base was left as a bulb on the bottom of the vessel. Then the vessel was built up from the base by coiling. Coil breaks should more likely occur in Sells Plain than in better finished redwares and decorated wares, but our sample of breaks was too small to prove this hypothesis. This appears logical, just as the inverse would seem true for repair holes; i.e., the more valuable the piece, the more likely a repair attempt would be made if it were broken (Schaefer 1975).

Two methods for thinning vessel walls were noted. Anvil marks indicated the paddle and anvil technique, and striae and other impressions were signs of scraping. Most Sells Plain vessels were hand finished, which sometimes involved just surface evening. Polishing occurred only about 25% of the time. Very often the polishing striations were widely spaced in streaks.

During manufacture smudged surfaces were normally polished and occasionally burnished, which may offer a general rule for differentiating

between sooting and decorative smudging. Combined, the exterior and interior polishing indicates smudging, while a lack of exterior finishing indicates sooting. Smudging does serve a possible function, as well as being decorative, by decreasing porosity or sealing the clay. Sooting may have acted much like stuccoing as a heat retention device and cooking aid (Rogers 1945b; Fontana 1965). During finishing, some Sells Plain vessels may have been slipped with a fine suspension of the same igneous clay used in construction, but this is often hard to distinguish from a highly polished surface where the compression of surface particles produces a false slip (Fig. 31).

Thickness - Various field studies report a range in thickness of Sells Plain pottery as summarized below.

Field Study	Range (mm)	Average (mm)
P.I.R. 1 Project	2.5 - 16.5	6
Scantling (1940)	4.0 - 22.0	
Di Peso (1953)		
Ramanote Plain	2.0 - 13.0	Just under 7
Paloparado Plain	3.0 - 10.0	Just under 7
Danson (1957)	4.0 - 9.2	6.3
Hayden (1957)	4.1 - 11.3	7.9

Rims - Rims of Sells Plain bowls are generally direct to outcurving, and in jars are direct to recurving. Various necks appear on jars, though the high neck, direct rim seems to be primarily a Classic feature. Classic period bowl rims tend to be flat or slightly elliptical (Fig. 32a-e,o,p).

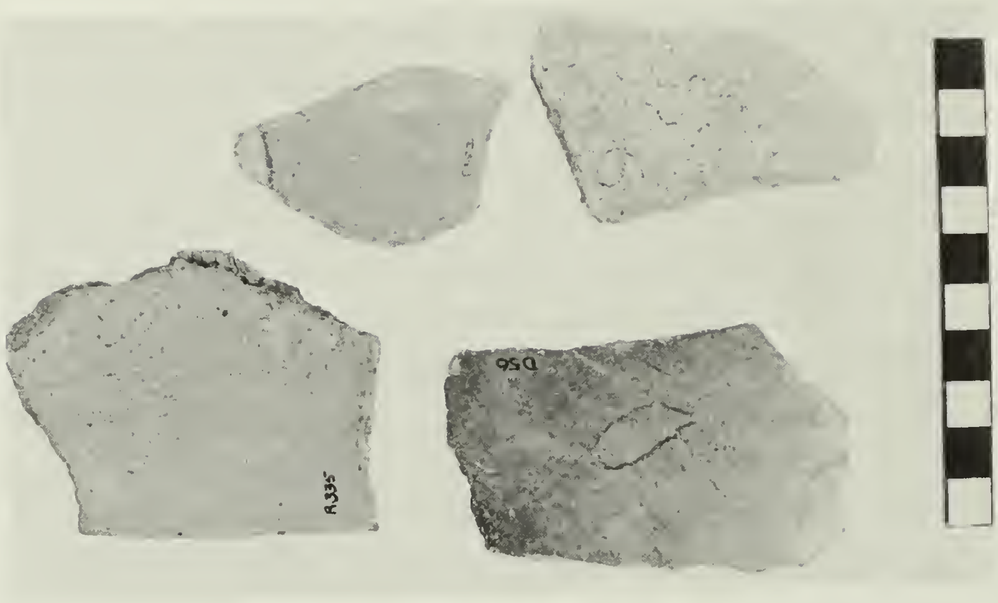
Sells Plain vessel forms cover a full range of sizes and shapes, although they are more likely to be large storage or cooking vessels than smaller personal dishes (DiPeso 1953). The most common forms are globular storage jars, outcurve hemispherical bowls, straight-sided bowls and seed jars.

Tanque Verde Red-on-brown

Tanque Verde Red-on-brown, first named at Tanque Verde Village (Fraps 1935), is the decorated ware of the Classic period Sonoran Brownware Tradition in the Tucson Basin and Papagueria (Table 4). While it previously has been thought that Tanque Verde occupied the time span between 1200 - 1500 (Scantling 1940), newer evidence indicates that it may have begun earlier and lasted later (Franklin and Masse 1976:49). Zahniser (1966) felt that a range of A.D. 1100 - 1300 was more accurate after his Rincon area survey. Haury (1950:6-7) stated that Tanque Verde Red-on-brown was produced in the Papagueria throughout the Sells Phase, A.D. 1250 - 1400. DiPeso (1956) expanded the phase even further, stating that Tanque Verde pottery was made at Paloparado until Spanish contact, about 1680. Greenleaf (1975a) considered the dates "1200 to 1400 and probably later" most relevant at Punta de Agua; however, the situation at that site may be different since the Rincon phase continued beyond the 1200's there.

It is not implausible that Tanque Verde Red-on-brown may have enjoyed a long popularity. (See Discussion.) Furthermore, it has been collected throughout the Sonoran Brownware geographical range. Our Papaguerian sample is small, with only about 250 sherds, but it was recovered from most of our sites, thus providing considerable information.

Paste - Like Sells Plain, Tanque Verde Red-on-brown has a residual clay paste. It is usually less coarse and shatters more easily in fracture than its companion plainware. These differences may be due either to more care during the clay preparation or to the use of a better quality clay. Possibly the hardness and shattering nature of the ware can also be attributed to a more efficient, hotter fire. Light brown is the typical color for Tanque Verde, 2.5YR 6/4 on the Munsell chart (1954), but it can range from a black (smudged) background through brown and red to a light buff. (The Munsell Chart is used here solely for color identification.)



a. Sells Red slipping and Sells Plain stuccoing.

b. A worn Sells Plain sherd.

Figure 31. Surface treatment of Sells vessels.

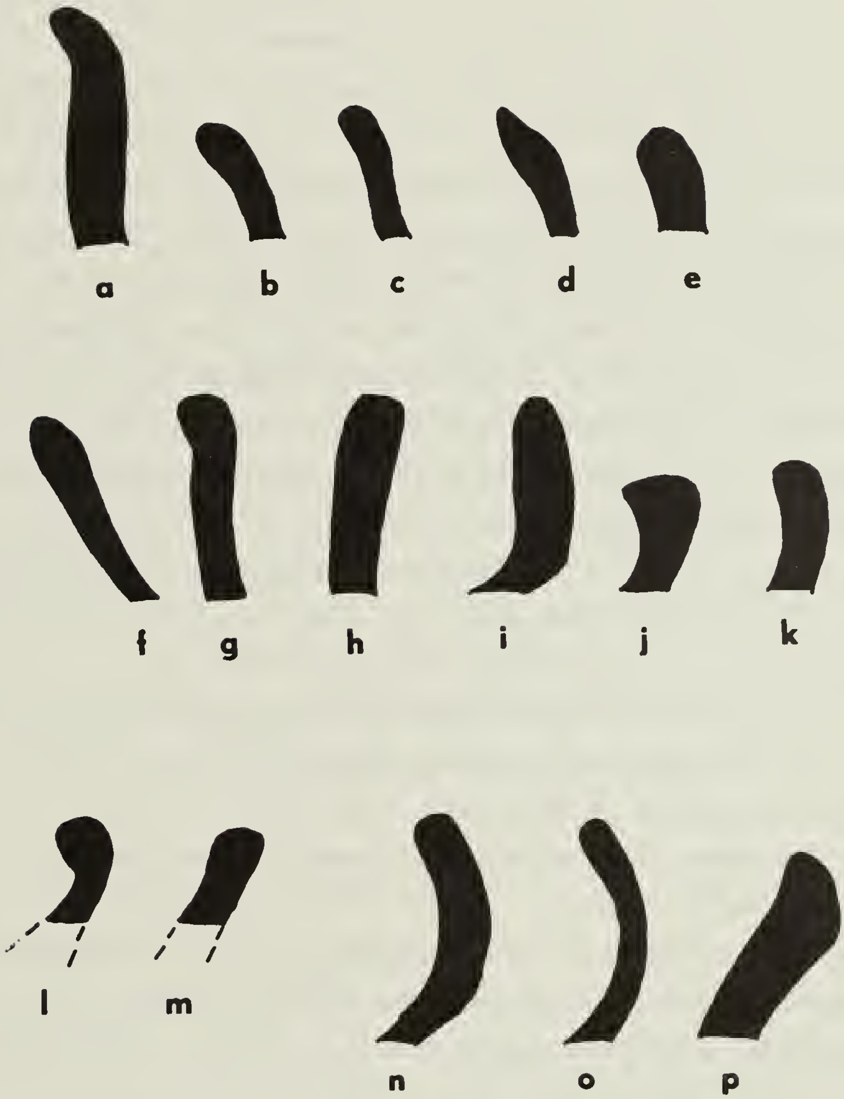


Figure 32. Sells Red Classic bowl rims (a-e,o,p); Sells Plain Classic bowl rims (f,h); and jar rims (i,p).

Manufacture - The paddle and anvil technique coupled with coiling is evident in Tanque Verde sherds. No signs of scraping for thinning the walls of bowls were seen during analysis, but marks were noted in jar sherds. This is logical because of the polished surfaces of the bowls (Haury 1950: 348); the polishing would cover signs of scraping.

None of our sherds showed the slip mentioned by DiPeso (1956) at San Cayetano, which probably represented an influence of the Trincheras ware, Nogales Polychrome (Withers 1941). However, a good portion of the Tanque Verde sherds from our sample did feature a grayish white scum coat on the interior similar to the scumming on Yuman and Hohokam buffwares (Rogers 1928), which may have been what DiPeso saw and labeled a slip. It is probably intentionally caused by the potter as it almost always completely covers the interior surface. It may have been that scums were first caused by salts in the soil and were unintentional, but through experimentation the coat was controlled and became a standard feature of the type, thereby approaching a glaze. Similar scums have been noted by other ceramicists (Shepard 1956). Tanque Verde is normally well-polished, depending on the grade of clay used.

Thickness - Tanque Verde Red-on-brown from the P.I.R. project sites averages 5.25 mm in thickness with a range of 2.5 - 8.5 mm. This is slightly thinner than those found at University Ruin (3.0 - 11.3 mm, averaging 6.5 mm). At San Cayetano (DiPeso 1956) the average thickness is around 6 mm.

Rims - Rims were mostly flat on both bowls and jars, although this may be misleading because few jar rims were identified. Bowls are generally deep and straight-sided with direct rims. A few rims had a slight flare beginning about an inch from the top (Fig. 32f-1).

Decoration - Like most decorated wares, Tanque Verde Red-on-brown has specific design elements. The arrangement of these is distinctive and easily recognized (Fig. 33). An ideal example, a bowl, has three areas of decoration. The primary field is an exterior, horizontal band covering

two-thirds or three-quarters of the vessel from the rim to a basal framing line, the secondary field is an interior band of pendants usually hanging from the rim and ranging from less than 3 to 5 cm wide, and the final field is a rim line across the top of the vessel, acting as the exterior and/or interior top framing line.

Within the primary field (the exterior band), the most common design technique is a pattern of diagonal panels or bands (Fig. 34, 35) or a combination of these (Fig. 33c). The handedness of the potter possibly may be predicted by the direction of the diagonal; i.e., top right to bottom left would probably indicate a right-handed artist. Theoretically, there would be a higher ratio of this layout. The band also may be aligned around the vessel, as in the small pot from Az.Z:14:33, Locus A (Fig.36b).

Other ways of sectioning the field in Tanque Verde Red-on-brown are diamond panels (Fig. 33e), triangle panels (Fig. 33f), triangle panels and bands combined (Fig. 33g) and "basket weave" (Fig. 33h). Design elements vary, as illustrated in Figure 35; generally they are rectilinear (Fig. 34 b,g,j,l) and have barbed or ticked line variations (Fig. 34i).

The paint itself is a dark, rich red, generally 10R 3/6 on the Munsell chart (1954). It is composed of well-ground inorganic iron-based minerals, which adhere tenaciously to the surface unless the paint cracked during firing, in which case it weathered, powdered or flaked.

Variants - A few sherds of one or two vessels of Topawa Red-on-brown (Withers 1941) were found at Az.Z:14:21. The features which distinguish Topawa Red-on-brown from Tanque Verde are: (1) the location of primary field is interior with exterior banding near the rim, reversing the Tanque Verde pattern (this appears as a transition between Tanque Verde and Rincon Red-on-brown, which generally has an interior design); (2) the triangular scroll design element is primary and may have been influenced by the Trincheras pendant triangle; and (3) the Topawa occurs in lower levels when the two types are found at the same site, thereby suggesting temporal precedence for Topawa.

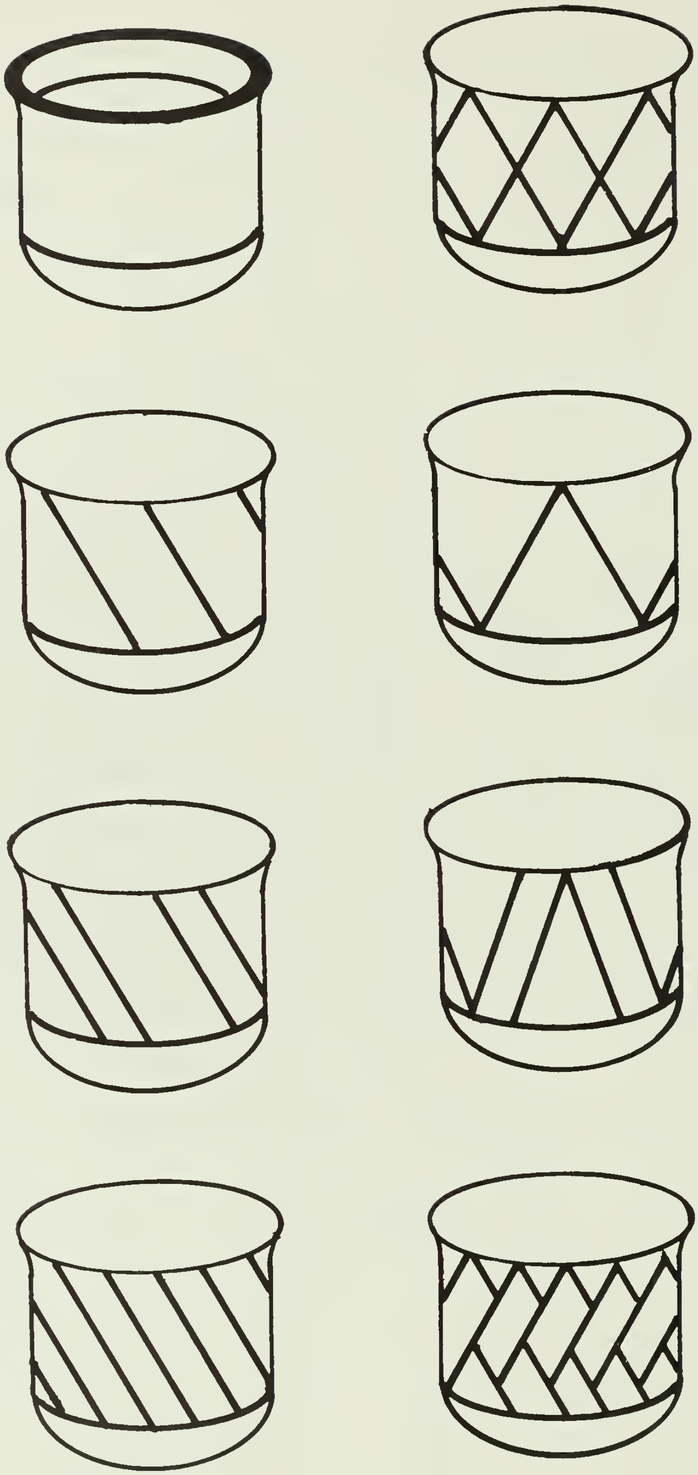


Figure 33. Tanque Verde Red-on-brown design layouts and construction.

The similarities between Topawa Red-on-brown and Tanque Verde Red-on-brown include: (1) the primary mode of decoration (i.e., the use of the rim and a basal framing line to delimit the primary field), full circumference panel and the preponderance of banding within the panel; (2) banding as a secondary field just below the rim; (3) rim forms; (4) primary construction techniques and (5) paste and paint. Obviously there are considerable similarities between Tanque Verde and Topawa. For these reasons, Topawa Red-on-brown has been considered an early variety of Tanque Verde in this study.

Because of the early dates we received from one of our sites for Sells phase (Appendix V), it is possible that Tanque Verde Red-on-brown was first made in the Papagueria (Discussion). Some of the later Rincon vessels from Punta de Agua (Greenleaf 1975a) have a primary exterior design which could have developed in the Tucson basin at the same time Tanque Verde was first being produced to the west.

Sells Red

Sells Red is a companion ware to Tanque Verde Red-on-brown in the Papagueria and is the Classic redware of the Sonoran Brownware Tradition. Possible progenitors for Sells Red abound. Kelly (n.d.) identified a thick-slipped redware known as Rincon Red at the Hodges site. Withers (1941) felt Valshni Red was being made at Valshni Village contemporaneous with Rincon Red, and Haury (Gladwin and others 1937) also noted a redware at Snaketown, resembling a micaceous Rincon Red called Sacaton Red. It is interesting to note that Sacaton Red, a thick-slipped redware, preceded the thin-slipped Gila and Salt Red in the Gila-Salt Basin.

Scantling (1940) described the Sells Red type which our sample follows fairly closely. He dated it at A.D. 1200 - 1400 but noted that it may have begun earlier in Valshni Red and could have continued with slight modification until A.D. 1700 evolving into Papago Red.

The spatial range of Sells Red may have been somewhat smaller than Tanque Verde Red-on-brown. It has been found as far east as the Santa Cruz Basin, south to the international border, north to Ventana Cave and

west at least as far as the Growler Mountains. Danson (1957: 231) felt that Sells Red was intrusive at University Indian Ruin. Because of the high occurrence of jars coupled with the apparent Hohokam-Salado influence at that site, this is not implausible. It is possible that the primary area of production for Sells Red was centered around the Baboquivari Mountains, and it was popular enough to have been traded widely throughout the Santa Cruz drainage and the Papagueria.

Paste - As is the case with other wares of the tradition, Sells Red is made of igneous clay. The inclusions appear to be the same as Sells Plain and Tanque Verde (Appendix VIII). However, fracture is generally more shattering than in Sells Plain, probably due to compression from polishing both surfaces, which aided vitrification.

The core is normally dark or possesses a carbon streak from incomplete oxidation of the carbonaceous material in the clay and from firing. Clear brown cores occasionally occur, as do dense black cores. (See Az.Z:14:33 below.)

Manufacture - The technique of manufacture is coiling, then paddle and anvil. The slip is colored a deep red, typically 10R 4/6 on the Munsell chart (1954), and is typically thick and easily distinguished from the body of clay. This follows the tradition established by the manufacture of Rincon Red, likewise identified primarily by the thickness and character of the slip (Kelly n.d.). Sells Red has a range of wall thickness from 3 to 11 mm, with a 5.5 mm average.

Finishing was done with a smooth stone and was probably begun while the vessel was still damp. Polishing is characteristically vertical on the vessel's body and horizontal at its rim (Appendix IX). Sells Red is smooth because of its polish, although a hammered effect, similar to that found in San Francisco Red, occasionally occurs. At other times the polishing striae form perceptible grooves. One example of each of these specific occurrences was found in our sample of 336 sherds.

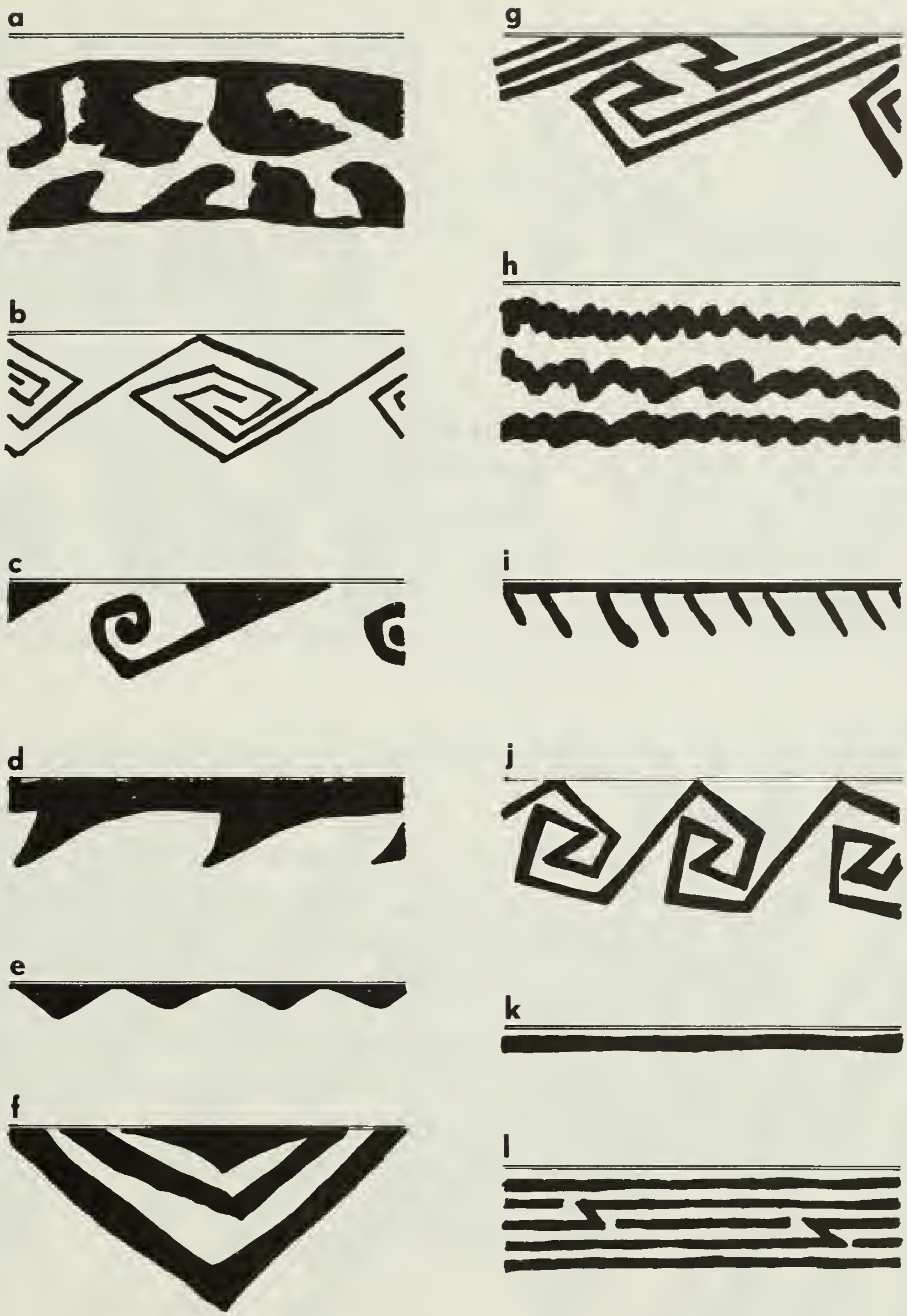


Figure 34. Design elements - a. Band; b-d,k,l. Diagonal panel or bands; e. Diamond panels; f. Triangle panel; g. Triangle panel and band; h. "Basket weave"; i. Ticked line; j. Rectilinear.

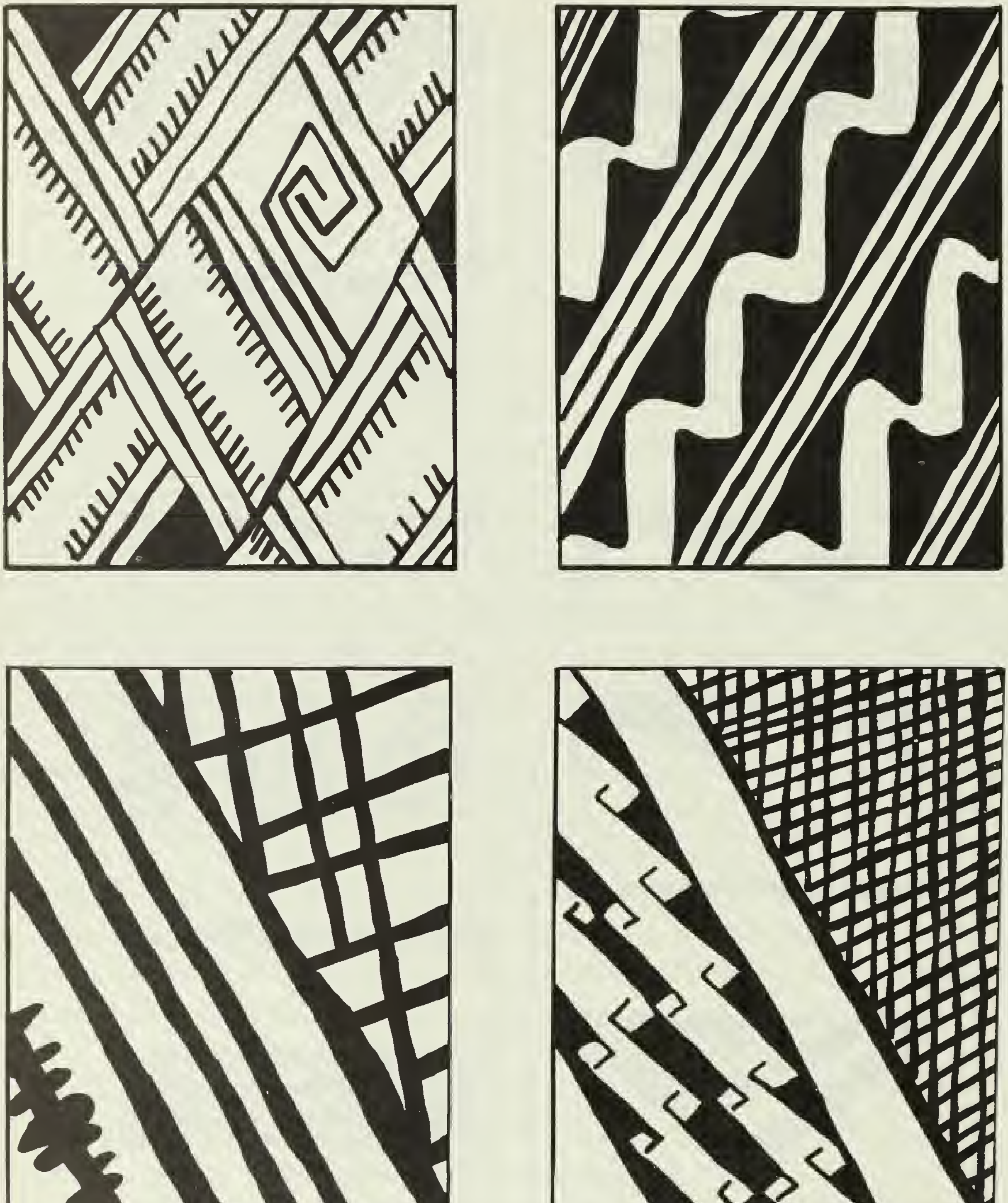


Figure 35. Combined Tanque Verde Red-on-brown exterior bands and panels.

Figure 36. Design element on partially restored vessels.
top - Papago Red-on-brown;
bottom - Tanque Verde Red-on-brown.

Rims/Forms - The most typical form of Sells Red vessels is the slightly flaring bowl. The rim is thicker than the vessel walls and is pinched, tapering to a sharp edge (Fig. 37). A few outcurve and straight-sided bowls were identified in our sample, usually with rounded rims. Jars are uncommon, and their identification is often made difficult lacking certain distinguishing features.

Preclassic Wares

Two preclassic types were noted in our sample. Rincon Red-on-brown, the progenitor of Tanque Verde Red-on-brown, was found in small amounts, with one partially reconstructible bowl coming from Az.Z:14:21, Locus C. The differences between Tanque Verde and Rincon Red-on-brown are in the design elements and the location of the primary field, which is generally on the interior of the latter type (Kelly, n.d.). The design layout of the vessel from Locus C is banded around the interior. Due to its association with Classic ceramics, our sample of Rincon Red-on-brown may belong to the postulated Cortaro or late Rincon Phase (Haury 1950; Greenleaf 1975a) (Table 4).

The final small sample belonging to the Sonoran Brownware Tradition is Valshni Red, associated with Rincon Red-on-brown and identified primarily from the same site. In our collection, this type appears to be a subcategory of Sells Red. As Withers (1941) describes it, Valshni Red is a hard-polished, red-slipped brownware. It is well-slipped and generally possesses polishing striae aligned vertically along the vessel. The core has no carbon streak according to Withers, but since this should refer to the amount of carbon left in the clay after firing (Shepard 1956), it might only indicate that some care was taken during firing to prevent contact with the fuel.

Papago Red

Fontana (and others 1962) and Gerald (1951) describe Papago Red, the principle ware of the Papago. Its range is limited to the Papagueria during the Historic period. In our sample it is a hard-polished, high-

gloss, slipped brownware, usually with a dense black core. The slip may or may not be thick, like that of Sells Red. Polishing is probably the primary distinction between the finishes of the two types. Polishing is done to a greater degree than on Sells Red, sometimes resembling a glaze. Papago Red is polished not only while damp but also when dry in order to improve its gloss and remove striations (Appendix IX). Because of the slip, Papago Red rarely shows the facets on the surface, common in Papago Red-on-brown, where organic temper has burned out.

Papago Red-on-brown

Only a few sherds, mostly from Az.Z:14:33, were identified as Papago Red-on-brown. There was one partially reconstructible bowl (Fig. 36a). If these sherds are Papago Red-on-brown, and not simply aberrant Tanque Verde Red-on-brown, they may represent a transition between Historic Papago and prehistoric ceramics. No dense carbon core is present in any of the sherds, indicating that horse manure probably was not added to the clay. However, a number of differences in these sherds led to their classification as Papago. The field is not structured, unlike Tanque Verde Red-on-brown. In the example of the reconstructed vessel already mentioned, the primary decoration is both interior and exterior. The design elements are atypical of those described earlier for Tanque Verde Red-on-brown. The paint is thinner, lighter in color and more likely to appear as a negative technique. This could indicate an organic base for the paint, a trait noted in other Papago ceramics (Fontana and others 1962: 77). Furthermore, most of these sherds lack the characteristic polish of Tanque Verde vessels (Haury 1950:346).

A glazed sherd in the sample strengthens an association with historic Papago. As previous work has suggested (Fontana and others 1962: 103-4), the glaze seems to be decorative.

Papago Glaze

The Papago glaze wares are Glaze-on-brown and Glaze-on-red. The latter comes from the Az.Z:14:33 site. These differ from Sells Plain and

Figure 37. Sonoran Brownware rims forms - a. Topawa; b,c. Early Tanque Verde Red-on-brown; d-k. Tanque Verde Red-on-brown bowls; l-n. Jars; o,p. Proto-Papago.

Papago Red only by the addition of glaze, usually in the form of a line of decoration.

A single brownware polychrome sherd which I have tentatively called Papago Polychrome was found at Locus C of Az.Z:14:33. The design consists of a chalky, eroded, white band with a red decoration superimposed. Whether or not this is an isolated aberration or represents an actual type cannot be established. Haury (1950:350) mentions both Papago Red-on-buff and White-on-buff (discussed by Fontana and others 1962: 103 as brownware); therefore, it could easily be a combination of these two.

Gila-Salt Basin Traditions

Ceramics of Hohokam culture derivation were represented by Gila Plain, Gila Red, buffwares and Wingfield Plain.

While the brownwares are of residual or igneous clays, buffwares are probably created from sedimentary or alluvial clays (Shepard 1956; Rogers 1945a; Colton 1953; and Hayden 1976: personal communication). The Hohokam added crushed quartz and mica to their ground clay as temper. A common trait of buffware vessels is a scum that forms on the surface during firing. Rogers (1928) stated that salts in the clay source produced the scum. Hayden (1976: personal communication) adds the idea that smoothing of the finished vessel with canal water, which was leaching more salts from the caliche-laden soil, produced the characteristic false slip.

Gila Plain

This was the most numerous type of Hohokam pottery found. As described by Gladwin and others (1937), it is, on the whole, thinner than Sells Plain, with copious amounts of finely ground muscovite mica and quartz particles as "temper." Scraping and polishing striae are common, running vertically on the vessel's body. Typically, the vessel exterior is gray and mottled from fire clouding, while the interior is a uniform light brown color (10YR 7/4 on the Munsell chart).

Gila Red

Gila Red resembles Gila Plain but has an additional thin red slip and occasional smudging on the interior. At most of our sites a few sherds were present but were most numerous at Az.Z:11:5. Most of the Gila Red vessels were slightly flare-rim bowls. The walls averaged 5.5 mm thick and usually had a dark core.

Haury (1976: personal communication) feels that our sample is slightly different from the type description he presented for Los Muertos Gila Red (1945a). The lack of uniform smudging and, in fact, the relative scarcity of smudging is also odd for the type.

Buffwares

Buffwares were the primary decorated ceramics of the Hohokam throughout their history. However, few buffware sherds were found during the Quijotoa Valley work; only one of these was really identifiable, a Snaketown Red-on-buff jar sherd from Az.Z:11:5. The Snaketown phase dates from A.D. 300 - 500 according to Haury (Gladwin and others 1937; Haury 1976: 326).

Lower Colorado Tradition

The Yuman wares common at two sites (see below) were fragmented. These sherds were not analyzed by one of the more involved typologies currently available (Schroeder 1952; Rogers 1945a), but rather were typed as a whole according to broad, temporal distinctions established by Rogers (1945a): Yuma I (approximately 800-1100), Yuma II (1100-1500), and Yuma III (1500-present). These distinctions are fairly recognizable from rim forms (Fig. 38). The lower Colorado Buffwares have a characteristic scum, more cohesive than that of the Hohokam buffwares, though not powdery.

The sherds are characterized by (1) a gray to buff color, (2) signs of both paddle and anvil and scraping manufacture techniques, and (3) direct rims, rounded in Yuma I times, flat in Yuma II times and with an extra coil in Yuma III times (Fig. 38). Scraping marks on the interior of

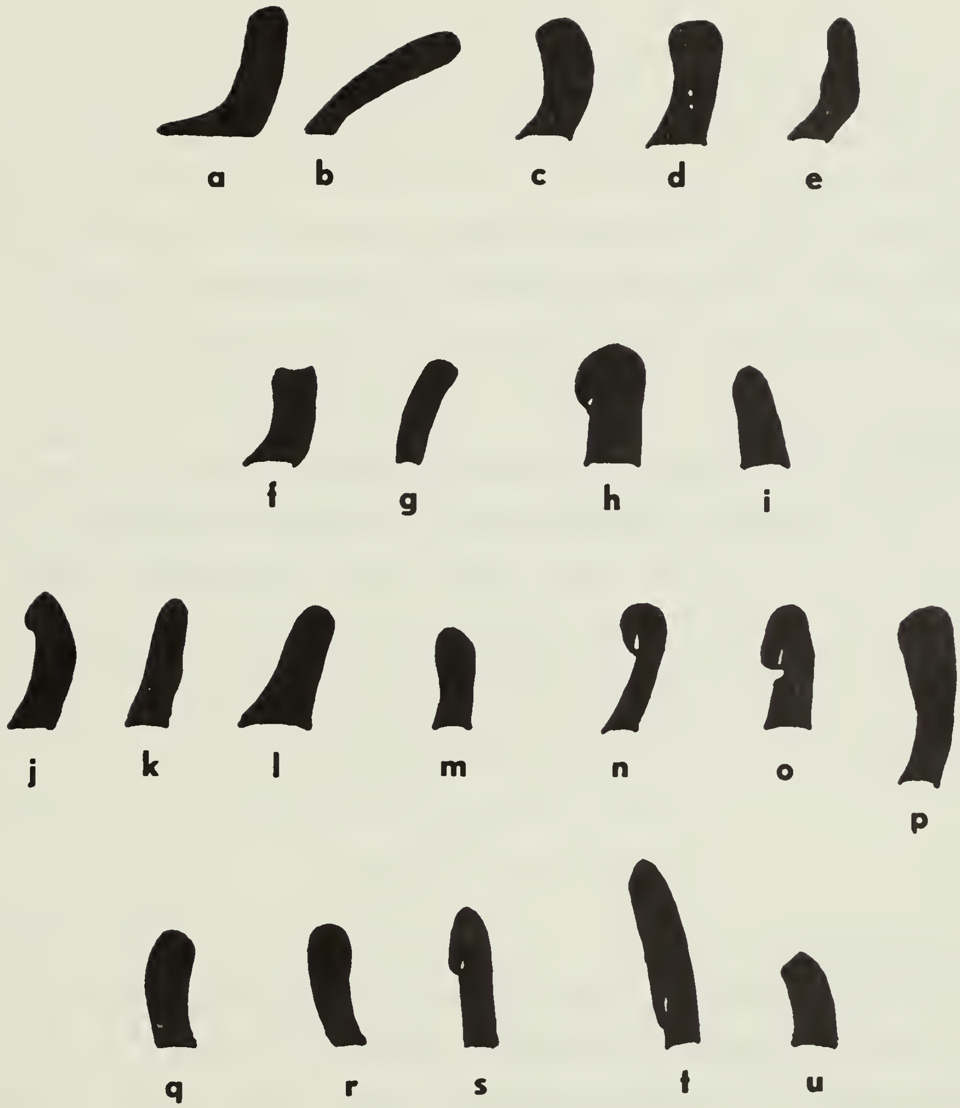


Figure 38. Yuman rim forms - a-g. Yuma II jars; h-i. bowls; j-p. Yuma III jars; and q-u. bowls.

jars are typical (Fontana 1965). Decoration is uncommon, and when it does occur, tends to be light orange-red and rather crudely executed. On the other hand, broad-line work is common. Scumming can occur either on the interior or exterior but more often on the latter. Because scraping marks are more common on the interior, Hayden (1976: personal communication) suggested that smoothing is responsible for the scum formation.

Rogers stated that stuccoing was a common feature of Yuman culinary wares, but no sherds of stuccoware were found at either of the two Yuman related sites. The only stuccoed examples from our collection are Sells Plain (Fig. 31a). This would imply that stuccowares may have been imitative of the Yuman vessels rather than of Yuman manufacture.

Yuman Redware

A single Yuman Redware sherd was found at Az.Z:14:33. It has been loosely called Colorado Red but probably represents either Yuma I or Yuma II times. It is a buffware with a thin, burnished red slip. Inclusions in the clay are mica and basalt, and an anvil impression is evident on the interior face of the sherd. It may have been part of a sherd disc at one time. If so, it was shaped not by grinding but by breaking. (See Worked Sherds.)

Miscellaneous Plainwares

Rhyolite-Tempered

Two other "types" were prominent in our collection. One with a purplish cast has been mentioned by Ezell (1954) as Wingfield Plain. What he evidently saw was a rhyolite tempering, similar to Wingfield's schist tempering. The rhyolite is not ground but remains in large blocky chunks comprising as much as 50% of the vessel's paste. This variant seemed to be more prevalent in the southern sites, although it was not numerous anywhere.

Disagreeing with Ezell, Hayden (1976: personal communication) suggests this type belongs to the Lower Colorado Tradition. A final

determination is by no means definite at this time. Interestingly, one of these sherds possessed exterior incising, highly reminiscent of that found in Gila Butte Red-on-buff sherds.

Orange Scum

The other unplaced type found in our sample is called Orange Scum ware. Generally, it is an orange-firing clay with a characteristic gray core and a scum similar to that seen both on the Yuman wares and on many Tanque Verde Red-on-brown sherds. Normally the orange color is limited to a thin band on the exterior surface, with a gray core up to four times as thick. It may be a sedimentary clay and, if so, may belong to the Sonoita drainage since the type is generally more prevalent at our southern sites. A sample of three sherds from a site near Quitobaquito included one sherd of this type along with two Papago Plain sherds. However, this temporal association points up the possibility of its Historic or protohistoric manufacture.

Individual Sites

A discussion of each site's ceramic component follows, excluding the sherd tabulation data previously presented in Table 7.

Kokotki, Az.Z:14:21

Three loci of this site were excavated. Ceramics collected at Loci A and B were Sells phase with Sells Plain, Tanque Verde Red-on-brown and Sells Red. Locus C had the heaviest concentration of material and was responsible for the largest ceramic assemblage from any one site (13,763 sherds). Sells Plain was overwhelmingly the most numerous type found; however, Gila Plain, Gila-Salt Buff, Tanque Verde Red-on-brown, Rincon Red-on-brown, Valshni Red and Gila Red were also identified from this locus.

Included in the analysis of the Tanque Verde Red-on-brown sherds was the Topawa variant of Tanque Verde. There were also two sherds of

aberrant Tanque Verde Red-on-brown. The latter at first were thought to be Vamori Red-on-brown but probably represent less careful work.

After examination, it is felt that the Az.Z:14:21 site presents an early Tanque Verde or late Rincon phase occupation. In fact this site might fall into the Cortaro phase postulated by Kelly (n.d.). Haury concurred, feeling it was the Project's earliest ceramic site.

Gu Vo 18, Az.Z:14:22

This is one of the most recent sites but was not a distinct activity area. Only a broken Papago pot, a large jar with a low recurve rim, was found here.

Shegoi, Az.Z:14:28

Locus A is primarily a Sells phase occupation. However, the presence of sherds of Rincon Red-on-brown, Valshni Red and one sherd of Trincheras Purple-on-brown indicated that occupation at this locus may have begun even earlier. The dating problem inherent in our sample is amply displayed by this collection as some ceramics antedate the site's primary occupation.

Locus B had few sherds but seems to represent a Sells phase occupation. It is notable that some Gila Plain sherds were found among the plainwares.

It is difficult to explain the existence of Sedentary ceramics in a predominately Classic period site. Within the area sampled, sedentary ceramics are localized; thus, it is conceivable, though not entirely plausible, that Az.Z:14:28 was primarily a Sedentary Rincon phase site with a small Sells phase locus, from which our sample was taken.

Bos Bosque, Az.Z:14:30

This is also a Sells phase site. Only one sherd of Gila Red and two of an early-looking Sells Red intruded upon an otherwise pristine collection of Tanque Verde Red-on-brown and Sells Red. Among the plainwares, there were several sherds of Yuman (Lower Colorado) wares and quite a few

examples of Sells Plain with slate and sand inclusions. Only one fairly large (14 g) sherd of Gila Plain was recovered in the entire sample.

Gu Vo Waw, Az.Z:14:32

Limited amounts of almost exclusively Yuman ceramics are represented in this site collection, belonging to Roger's (1945a) Yuma II phase. Direct flat rims predominate though a few rounded rims occur. Two Sells Plain rims, both from "seed jars," and one rim from a sand and schist ware, flare-rim bowl were found. A number of sherds of the schist-tempered ware were found here, but they were not like Wingfield Plain. Instead, they could have served the same function while being simply a variant of the Yuma II type.

It is unclear whether Az.Z:14:32 represents an actual Yuman use of the area, or if it is a Sand Papago site (Hayden 1967, 1970), but the presence of so few Sells Plain sherds and schist-tempered wares, along with the Colorado Buff seem to indicate the latter. (See Discussion.)

Gu Vo Hiktani, Az.Z:14:33

Like Az.Z:14:21 this site possessed three loci. The second largest ceramic sample was found at Locus A, the primary locus, which was identified by Haury as the most recent Sells phase collection from the Project area. There were indications among the ceramics that the site might represent both late Classic and Transitional periods. Transitional refers to that amorphous period between late prehistoric and early Historic times.

Most of the decorated wares were identified as Tanque Verde Red-on-brown. There were a few aberrant sherds and a portion of a small "bean pot" bowl (Fig. 35a) which suggested Papago Red-on-brown, certainly odd for Tanque Verde. The bean pot in particular breaks all design rules of Tanque Verde. The primary field is both interior and exterior, and there is no rim line. The elements are scrolls, dots, "arc-ladders" and lines, and the paint is so thin that it appears like a negative technique over most of the vessel.

Among the redwares several dark cores resemble the manure tempering of historic Papago wares. Whether this implies early experimentation with the technique of vegetal tempering or is simply an aberration of Sells Red (incomplete oxidation) is not definite. After analysis was completed, it was noted that in the unidentified redware category there were more jar sherds, whereas Sells Red sherds were mostly bowls.

The plainwares show considerable variety at this site. Basalt, schist, slate and mica were all common, naturally occurring inclusions in the region's clays used to make Sells Plain. Furthermore, Gila Plain and several unidentified buffwares are poorly represented in the collection. One sherd with rhyolite temper was found.

Sells Plain bowl forms from Locus A were outcurving to straight-sided. Jars included "seed jars," wide mouth jars, high neck jars and recurve rim storage jars. The redwares are typically Sells form bowls with slightly flaring rims or variations of the bean pot mentioned earlier.

Decorated wares were mostly bowls, characteristically straight-sided or slightly flared. One red-on-brown jar with a fugitive design had a high neck with recurved rim (Fig. 34a). Jars tend to be wide mouthed varieties with short necks. Two prehistoric Papago ("proto-Papago") rims suggest a wide mouth jar and the aforementioned "bean pot."

Az.Z:14:33 Locus B was undistinguished. Because the sample contained only a few hundred sherds from the entire site, no date could be applied to its possible occupation. Locus C appears to be a Sells phase site, but due to its limited sample, identification is again based on speculation.

Ali Chuk 8, Az.Z:14:40

This site was only minimally surface collected and not excavated; it was avoided during road work. An interesting pattern of ceramic types emerged from the selective surface collection. Both Sells Red and Yuma III sherds were recovered. This implies that Sells Red existed close to the Historic period, which would alter the accepted temporal markers by at least 100 years. Recognizing the limitations of our collection, it is

equally reasonable to assume that there are two loci at the site, one Sells and the other Yuma III.

Az.Z:14:43

This is a Yuma II site with only a few brownware sherds. Interestingly, the only decorated wares from this site were red-on-brown. Unfortunately, their types were unidentifiable but were possibly Tanque Verde. The combination of Yuman wares and red-on-brown sherds, without distinctive types of either, may suggest that neither were produced by inhabitants of the site. The site is, therefore, possibly a Sand Papago occupation.

Ali Chuk 24, Son.C:2:15

Ali Chuk 24 is primarily represented in our sample by sherds of Papago Red, which appear to come from one vessel, a canteen-like jar. A few of the "canteen" sherds are so darkly fire-clouded that they appear to be smudged plainware. There are also several Sells-Papago Red sherds and a rim sherd from a flare-rim bowl.

Huihikiwani, Az.Z:11:5

While the Sells phase occupation of Az.Z:11:5 resembles many of the other P.I.R. 1 sites, it is perhaps the most distinctive site ceramically. Among the types present were Tanque Verde Red-on-brown, Sells Red, Sells Plain, Gila Plain, Gila Red and a handful of buffwares. The variety of ceramics compares with other Sells phase sites, but the large amounts found make the site unique. While the same three brownwares -- Sells Plain, Sells Red and Tanque Verde Red-on-brown -- dominate the collection; the amounts of Gila Plain and Gila Red, with their variants reflect the site's northern location and show Hohokam influence. Much of the Sells Red and Sells Plain from here were typical, except that mica was added to the paste.

One interesting sherd was a Snaketown Red-on-buff with a high polish finish. It was the only indication of an early ceramic occupation (300-

500 A.D.) in the project area. There was also a redware with a very small patch of glaze which probably came from some later site nearby.

Unlike samples at other sites, the Gila Plain at Az.Z:11:5 was highly distinctive and easily separated from Sells Plain. The vessel forms of Gila Plain trend noticeably toward large globular jars. Their regular form suggests, first, a specific use, and, second, the possibility that they are intrusive, perhaps being traded from the Hohokam villages to the north. The only other associated Hohokam ceramic is Gila Red, so it is likely that Gila Plain is intrusive here.

Its appearance could also be a matter of available materials; both Gila Red and Gila Plain seem to be manufactured from igneous clays. Technologically the Huihikiwani potters were less precise than Hohokam potters, but probably were capable of reproducing the thinner Hohokam wares. Thus, it seems possible that these wares could be imitations of Hohokam vessels. This offers an explanation for the two differences noted in our sample and the accepted type descriptions. In the Gila Red there was no interior smudging which is very common in Gila-Salt varieties of the type. In the Gila Plain there were few vessel forms; most of the sherds were from large globular jars. The reason for such imitation may be the site's northern location, close to the Hohokam occupied areas of Santa Rosa Wash and Gu Achi.

The petrographic analysis (Appendix VIII), however, suggests an alternative explanation. The Gila Plain and Gila Red sherds do not compare very closely to each other. The Gila Plain seems to be different from all other wares, while Gila Red seems more similar. The Gila Plain then may be intrusive, while Gila Red is imitative.

Worked Sherds and Other Ceramic Objects

Worked Sherds

Table 7 summarizes the data recorded on 96 worked sherds. They were identified first by type, then by general shape. Approximate size was determined for some of the worked sherds, but many were too irregular or

too fragmentary to measure. The methods of manufacture were breaking, grinding or combinations of these, while some were shaped through wear. Perforations were noted and a question mark was placed on the chart if it was impossible to ascertain whether or not the sherds had been perforated.

Those sherds marked with an asterisk indicate probable spindle whorls. Other worked sherds include two possible pottery anvils and a few probable scrapers. One specimen possessed grooves along one edge which resembled serrations but were rounded. A large polished and smudged Sells Plain base sherd was crudely shaped into a shallow bowl by breaking and may have served as a pot rest or base mold.

Molded spindle whorls are diagnostic of the Classic period Sells phase. Sites such as Guasave (Ekholm 1942) and Chametla (Kelly 1938) are thought to have provided the impetus for the manufacture of these artifacts. Two of these specialized ceramic objects were found at Valshni Village (Withers 1941), 26 were found at Jackrabbit Ruin (Scantling 1940), and 34 were recovered at Los Muertos (Haury 1945). A few of the latter 34 were red-slipped as were 19 from Jackrabbit Ruin.

Only one of our six whole or partially molded whorls was red-slipped (Fig. 39d). As typed by Haury (1945), Figures 39a and 39e are thin biconical forms with flattened borders, while 39d and 39f are more typical of the biconical specimens illustrated from Los Muertos, also having the flattened border. All four of these partial whorls are from Az.Z:14:33 Locus A. The complete spheroid type specimen (Fig. 39b) is from the pithouse at Az.Z:11:5, and the pulley type is from an excavated unit of Az.Z:14:30 (Fig. 39c).

The recovery of molded spindle whorls from three sites solidifies their temporal association according to diagnostic ceramics. Since the molded whorls are considered to be Classic, it was thought that there might be some connection between them and the occurrence of the perforated sherds that were probably used as whorls. The perforated sherds came from the same sites as the molded whorls with the notable addition of Az.Z: 14:21, which is Sedentary or Early Classic, so molded whorls would not be expected there.

Clay Daub

A small piece of clay was found in what was thought to be a floor surface at Az.Z:14:21 Locus C. It was categorized and later identified by Haury as a piece of daub showing impressions of vegetal material on either side. The discovery of building material helps substantiate the preliminary identification of a house floor there.

Conclusions

The limited nature of our samples precludes sweeping conclusions, but several interesting possibilities are indicated. Theoretically, certain precepts should exist that identify something as definitive as a tradition. What defines the Sonoran Brownware Tradition?

As the plainware of the Sonoran Brownware Tradition, Sells Plain exhibits clay characteristics derived from igneous rocks, inclusions of the parent rock and coarse grain size. In our brownwares a generally low firing temperature is characteristic (Appendix IX). Polished and/or smudged brownwares (Sells Plain), manufactured by coiling, paddle and anvil and sometimes scraping, are also indicative of the Sonoran Brownware Tradition. Vessel forms of Sells Plain are similar to and often influenced by the Hohokam Gila Plain. This contributes to the problem of identification (Greenleaf 1975a). It also encourages lumping regional variants into a single type because of apparent overall similarities.

It is my contention that Sells Plain, Tucson Variety-Gila Plain, Ramanote, Paloparado Plain and other plainwares of the Sonoran Brownware Tradition should all be grouped under the heading Sells Plain. The term Gila Plain should be reserved for the Riverine Hohokam culinary ware, including Wingfield Plain. The specialization and standarization of Gila Plain in our sample (most of it from Az.Z:11:5) indicates that it may be intrusive. This contention can be substantiated by the petrographic analysis (Appendix VIII).

It is plausible that Gila Plain vessels originally contained a trade item. It is a finely made plainware, representing greater time investment

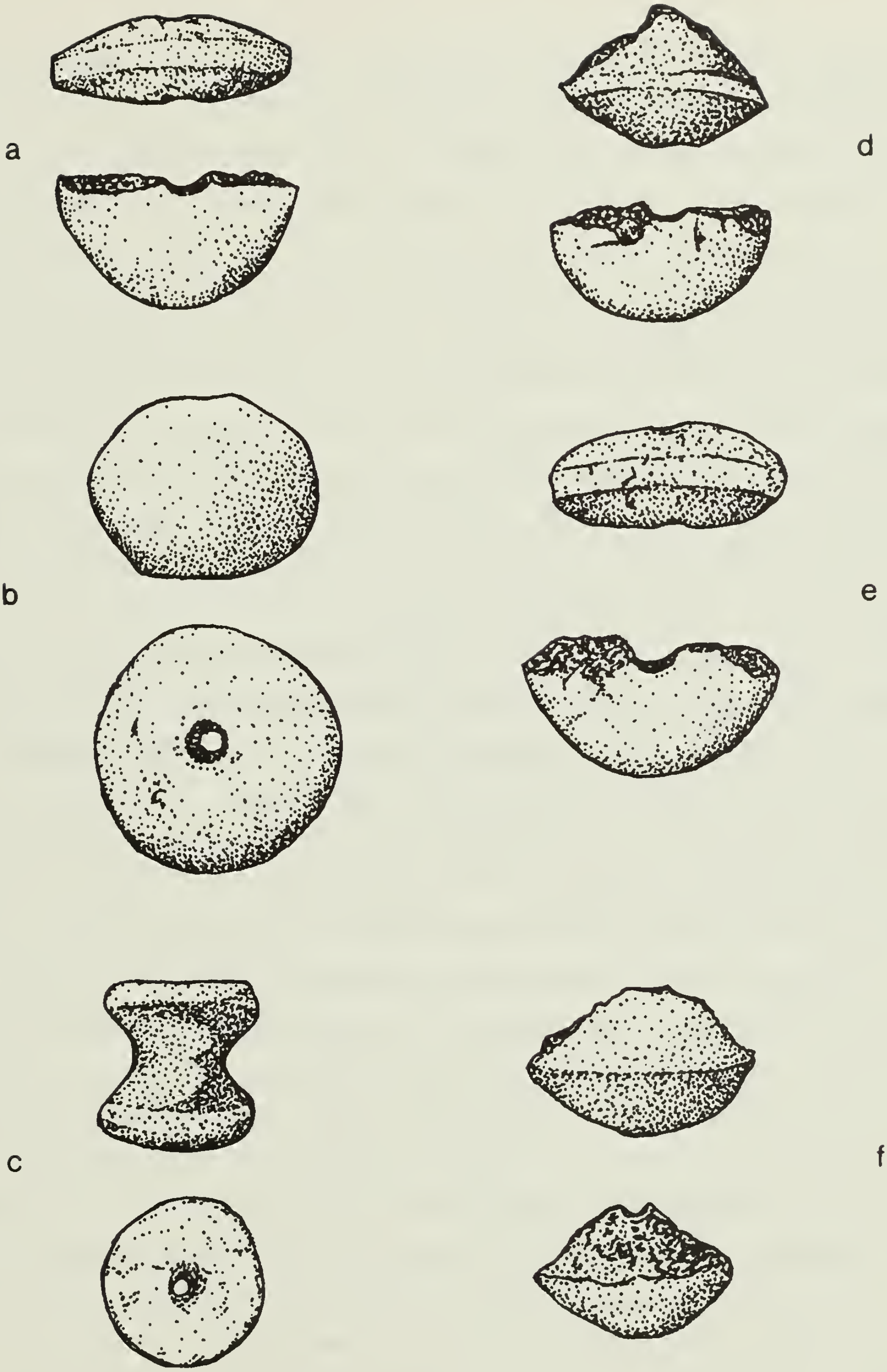


Figure 39. Complete and partially molded spindle whorls - a-e. From Arizona Z:14:33 thin biconical forms with flattened borders; d, f. Los Muertos-type biconicals; b. Complete specimen from Arizona Z:11:5 pit house; e. Pulley type from Arizona Z:14:30.

and precision of technique than that of the Sells Plain. This reinforces the distinction between Sonoran Brownware and Gila Plainware.

The exclusive presence of Yuman wares at several sites may be the best indication of a prehistoric-modern Papago continuum. The problems faced in identifying Yuman wares were resolved by simply organizing the sherds of this tradition into one of the following categories: Colorado Buff, including all Yuman buffwares; Colorado Brown, including all Yuman brownwares; Colorado Red, including any red-slipped Yuman wares; and Colorado Red-on-buff, including any decorated Yuman wares. Temporal designations were given the Colorado Buff rims (this type formed the bulk of the material) per Rogers' (1945a) notes as Yuman I (A.D. 800-1100), Yuman II (1100-1500) and Yuman III (1500-present). This classification proved most informative and avoided a complex typology.

It is significant that Yuman wares were found at a locale so far from the Colorado River. This reinforces the presence of Sand Papago (Hayden 1970) historically in the Papagueria since the Quijotoa sites with Yuman pottery are believed to be examples of Sand Papago, not Yuman, occupation.

Within these three traditions particular problems should be highlighted. The limited presence of Sells Red presents a puzzle. Haury (1950: 346) stated that Sells Red was made in proportions equal to Sells Plain at Ash Hill and Jackrabbit Ruin. Yet at Az.Z:14:33 Locus A, nearly 6,000 Sells Plain sherds weighing over 30,000 grams were found, compared with less than 250 sherds of Sells Red, weighing 1,340 grams. Even assuming all of the unidentified redwares are Sells Red, and adding them to the previous total, Sells Red still comprises only four percent of the total collection. Consequently, while there is little doubt that Sells Red and Tanque Verde Red-on-brown (found in even smaller amounts) were being made in the eastern Papagueria, the possibility that these wares were traded into the Quijotoa Valley must also be considered.

It seems plausible that our valley sites were seasonally occupied for the purpose of shell exchange, food collection or agriculture. It is also reasonable to assume that the people whose cultural debris we have collected may have brought few decorated or redwares with them to these sites.

However, they may have made plainwares at the site, which would explain the great variation among them. Basalt in the paste could indicate use of a clay source near the Gu Vo Hills, while orange scumware could mean use of a sedimentary clay source in the Sonoita River and thus explain its southern occurrence.

As can be seen in Table 6, the sand-with-basalt wares were found at our earliest site, Az.Z:14:21, and at our latest, Az.Z:14:33 Locus A. The existence of the ware at both sites again suggests the same clay source. If the tradition of using the same clay source were maintained for several hundred years, then it can be further speculated that these two sites represent a slight southward shift of the same cultural group through that time period. This is conjecture, but it helps to illustrate possible movement of habitations over a period of generations.

Who were the highly mobile people living in the Papagueria? From their ceramics, they appear to be the same people who occupied the Tucson Basin. Whether they were an upper Piman group like DiPeso's "Ootam" (1953), an adaptation like Haury's "Desert Hohokam" (1950) or the predecessors of some later group such as the Sobaipuri or Papago is difficult to say. They could have been Piman people like those who absorbed the remnants of the Hohokam in the Gila-Salt Basin between 1500 and 1700 A.D. (Hayden 1970). Obviously, different interpretations are possible even from the limited ceramics recovered. Segments of the ceramic analysis, particularly of the decorated wares, can offer speculative support for the idea of a prehistoric to historic continuum.

The development of Papago Red could be a natural continuation of the increase in redwares seen during the Classic period. The reliance on redwares could thus explain the apparent "degeneration" of decorated ware in Papago Red-on-brown. It is possible that Tanque Verde Red-on-brown led directly to Papago Red-on-brown, but this is not strongly indicated by our data. It is also possible that these sherds are merely highly aberrant examples of Tanque Verde that were the product of a single artisan, or they may indicate an occupation at Az.Z:14:33 by a group which eventually became the later Papagos. Whether the makers of Papago Red-on-brown were

contemporaneous with those of Tanque Verde Red-on-brown or were the only people there and Tanque Verde was intrusive cannot be determined with our sample.

However, it is also possible that the Papago Red-on-brown was the first decorated ware to be made by the Piman people and that Tanque Verde was intrusive from sites like Jackrabbit Ruin or Valshni Village. If so, the presence of an indigenous population in the eastern Papagueria prior to the Papago, perhaps originating from the Tucson Basin, would be indicated at these eastern sites.

It is hard to find a link between Papago Red-on-brown and Tanque Verde Red-on-brown. The decorative elements of the Papago ware are very similar to Colorado Red-on-buff, the Yuman decorated ware. Again this points to possible Yman influence on the Papago prior to the coming of the Spaniards. Redwares, in contrast, appear to have developed from Sells Red of the Sonoran Brownware Tradition. Sells Red owes its inception to its Rincon and Valshni Red predecessors, but the source of these types is unknown.

The possibility of Mexican influence, suggested by Withers for Valshni Red, seems to be the most plausible explanation. Haury (1950: 17) noted the close resemblance between Valshni and Guasave Red. Ekholm (1942) reasoned that the Guasave redwares owed their inception to a postulated northern redware complex. This would place redware production prior to the 1300's in an area between Guasave, Sinaloa and the Sonoran Tradition area. At Guasave, Ekholm (1942) found considerable amounts of Guasave Red, resembling the Sedentary wares of the northern Sonoran Brownware in slip, polish and color. Hence redwares of the Sedentary and Classic in the Tucson Basin seem to owe their development to this ware. The Classic Hohokam redwares, on the other hand, are probably the product of northern and eastern influences (Haury 1945).

This southern development of Sonoran redwares, which contrasts with the northern influence of Gila-Salt redwares, also affects vessel form. Especially notable is the preponderance of bowls over jars in Sells Red, with a 6:1 ration at Huihikiwani as compared with approximately 2 or 3:1

for Gila and Salt Red at Los Muertos (Haury 1945). The use of redware jars seems to be more prevalent in Hohokam ceramics than in the Sonoran Tradition where bowls are preferred. This could indicate cultural differences between the Hohokam and their Sonoran neighbors in the function of their ceramic wares and in their lifestyles.

The development of the Red-on-brown type is unclear. The identification of Topawa Red-on-brown (Withers 1941) as a separate type is based on three tenuous factors: (1) the reversal of its design layout, (2) its single triangular scroll design element and (3) its association with earlier levels at Valshni Village. The latter appears to be the only viable distinction. On one hand Topawa could be a transitional ware between Rincon Red-on-brown and Tanque Verde Red-on-brown. Examples of certain elements distinctive to both styles were collected. On the other hand the style of the southern Papagueria area could be more strongly influenced by Trincheras ware, thus accounting for the presence of the triangular scroll element also noted for Trincheras Purple-on-red (Johnson 1960).

However, the diamond cross-hatch is perhaps a more common design both on Trincheras Purple-on-red (Johnson 1960) and on the Tanque Verde Red-on-brown. Rim pendant trinagles, which could have led to the triangle scroll and banded designs, are also common to both wares. If Tanque Verde Red-on-brown developed first in the eastern Papagueria at sites like Valshni Village rather than in the Tucson Basin, then its similarity to Trincheras Purple-on-red could be significant. In that case, Topawa Red-on-brown could link the Trincheras and Tanque Verde during the postulated Cortaro phase of the Papagueria (Haury 1950: 347; Kelly n.d.).

In review, analysis of Quijotoa Valley ceramics demonstrates:

1. A unified brownware ceramic tradition in southern Arizona and northern Sonora known as the Sonoran Brownware Tradition (Ezell 1955: 369).
2. Considerable inclusion variation in the paste of the region's primary plainware, Sells Plain (Scantling 1940).

3. Limited occurrence of diagnostic ceramics, i.e., decorated and redwares at sites of the western Papagueria.
4. Indications of the intrusive nature of Hohokam ceramics during the Classic period at shell trade sites of the western Papagueria.
5. The possible existence of Sand Papago sites as early as A.D. 1100 in the western Papagueria.
6. The indication of some transitional ceramic elements between prehistoric and historic Papago wares.

Further research should be directed towards precise dating of sites and identifying subsistence patterns at different sites to clarify many of the peculiarities of this ceramic sample. An attempt should be made to locate any Classic Hohokam or Sedentary Sonoran Brownware sites in the Papagueria, the existence of which would tend to disprove the apparent rise of the latter tradition in the area during the Classic period. Failure to locate these sites would seem to support the model of Hohokam abandonment of frontier areas after the Sedentary and corresponding expansion by the people of the Sonoran Brownware Tradition.

Figure 40. Uniface from Pit house, Level 2, Arizona Z:11:5.

CHIPPED STONE

By

E. Jane Rosenthal

Over 20,000 pieces of chipped stone were collected during fieldwork activities along P.I.R. 1 and P.I.R. 34. This artifact assemblage consisted of 677 cores, 1,389 flaked tools and more than 18,000 waste flakes (Table 3). Because this large quantity of worked stone was recovered in a small number of subsurface tests and during limited collecting within the right-of-way, it appears that chipped stone is a significant component of

the Project's artifact collection. All categories of chipped stone material, finished and unfinished tools, whole and partial pieces of debitage and utilized stone, were studied. Therefore, a primary goal of the second phase of research was to answer questions about the function of chipped stone tools and their cultural affiliation.

Jones (1974:18-19), noting that our initial survey collection had high percentages of retouched, denticulated and notched flakes, asked these questions: "Do the crude ragged edges displayed by many of the denticulated tools reflect true functional designs? Are the denticulates simply facile, rapidly-manufactured products or a disposable tool tradition?" As field and laboratory analysis proceeded, his inquiries were restated.

1. Materials - What stones were selected for tool-making in the Quijotoa area? What does the debitage indicate about workability and technology?
2. Tools - What stylistic regularities occur in their shapes and sizes? How much workmanship is involved in tool manufacture?
3. Traditions - What techniques of manufacture were being employed? Are techniques of manufacture time specific?
4. Activities - Can tool production areas be identified? Can areas of resource exploitation be identified?

Not all the above questions proved answerable, but they were investigated to learn more about the cultural traditions and the aboriginal land use of the Quijotoa Valley.

Debitage and Cores

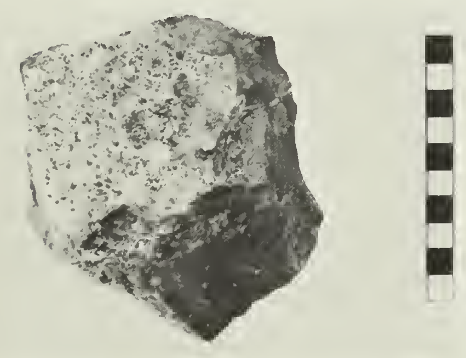
Crabtree (1972: 58) defines debitage as "residual lithic material resulting from tool manufacture." This group includes exhausted or abandoned stone nuclei (cores) from which laminae were removed, flakes and the discarded end products of tool manufacture (shatter)(Fig. 41).

Several problems were dealt with during the debitage analysis. The first was separating utilized from non-utilized objects in a primarily

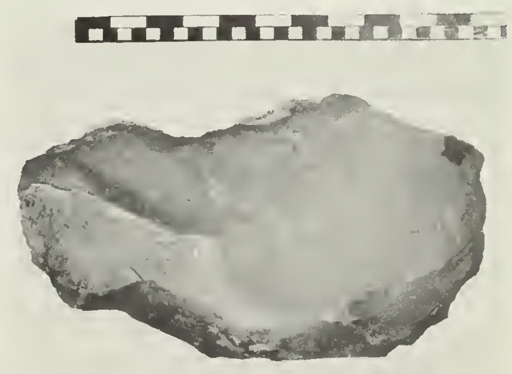
igneous assemblage. (Despite inspection of all stone artifacts, no doubt a minor percentage of the debitage may have been utilized. Igneous debitage is particularly difficult to sort because macrowear is less apparant on non-vitreous, coarse-textured materials.) The second problem was sorting and tabulating specimens for information on their manufacturing techniques. The third problem was identifying stone working traditions represented by our partial and mixed surficial data. We were somewhat successful in dealing with the first two problems. As for the establishment of techniques, our suggestions are only hypotheses which must be tested in more contolled situations in the future.

Methods

In the field all stone that was possibly altered by man's activities was collected. Then in the laboratory, unworked material (stone lacking attributes relating to the "cone of force") was removed from the inventory. Subsequently, specimens were inspected with the aid of a 10-power hand lens in order to further separate used from unused artifacts.



a. Jasper core, Arizona Z:14:43.



b. Large primary flake, Kerwo Quarry near Arizona Z:14:32.

Figure 41. Chipped Stone.

It is always difficult to establish whether a flake or a core has been used if macroscopic alteration to the tool's edge is not apparent. Even with a high-powered microscope (360-power), some tools display no evidence of wear (Brose 1975: 88). Four primary types of macrowear were identified in our Papago Project assemblage: breakage, edge crushing, serial stepfracturing and polish. In addition erratic retouch was evaluated to see if edge alteration was deliberate. At times accidental macrowear was identified because of differential oxidation of the scar and the tool.

We used the absence of (1) systematic serial retouch on the edge, (2) intense step-fracturing or crushing and (3) dulled and glossy edges to determine if an object was debitage (Tringham and others 1974: 185-92). This debitage sorting procedure was based upon a model of Hohokam stone reduction presented by Crabtree (1973: 10-45). If all of the three were absent, the artifact was placed into one of 10 debitage categories (three core and seven flake types). Their defining attributes follow.

1. <u>Nucleus</u> (<u>Nodular Core</u>): a nodular mass of stone with multiple negative scars; primarily embryonic.
2. <u>Flake Core</u>: a large flake which has had several flakes removed from it and, therefore, displays multiple negative flake scars.
3. <u>Cortex Flake</u>: a flake greater than 3 cm long that has a natural rind on its nonbulbar (outer) surface.
4. <u>Cortex Removal Flake</u>: a flake greater than 3 cm long and having a rind on more than 30% of its outer surface.
5. <u>Primary Flake</u>: a flake greater than 3 cm long and having less than 30% cortical surface. It has at least one distinct negative flake scar on its outer surface.
6. <u>Secondary Flake</u>: a flake which is less than 3 cm long and has no cortical surface, a prepared platform and at least one negative flake scar on its outer surface. It is a finishing or resharpening flake.
7. <u>Secondary Cortex Removal</u> (<u>Trimming</u>) <u>Flake</u>: a flake less than 3 cm long which has retained portions of the cortex on its outer surface.

8. Bifacial Thinning Flake: two types of this flake occurred. Both are thin diverging flakes with wide platforms. The sidestruck flake is a percussion flake produced with a hard-hammer technique, while a bifacial thinning flake is produced with a soft hammer.
9. Blade: a specialized primary flake which has parallel edges and is at least twice as long as it is wide. It has at least two negative flake scars on its outer surface.
10. Exhausted Core: a small stone piece with multiple negative flake scars less than 3 cm in length and displaying multiple unrecoverable platforms.

The number of representatives in the above categories were charted on a gridded sheet for each provenience, listing flake types vertically and stone varieties horizontally. An SPSS (Statistical Package for the Social Sciences, Nie and others 1975) sub-program was used to perform a series of computations of Pearson's product-moment correlations for pairs of variables. The overall strength (percentages) of the relationships between flake and material types at various loci were measured. Then frequency data was tabulated for all sites. This information is summarized in Tables 8 and 9.

During morphological analysis of the 677 core specimens we developed a more elaborate descriptive system. Individual artifacts were comprehensively described by their attributes like material, platform type, direction of flaking, number of scars, type of bulb of force, types of mistakes, platform crushing and core dimensions. Data were cross-tabulated with an SPSS sub-program for attribute frequencies and core types. The distributions of cores at major loci were plotted on gridded site maps so that possible manufacturing areas could be isolated; none were confirmed.

Materials

The types of stone used by the toolmakers working at the Quijotoa Valley sites varied. Amounts of different rock types varied among sites. Igneous rocks predominated both in quantity and variety. Whether this

Table 8 CHIPPED STONE ARTIFACTS

Sites	Debitage	Cores	Tools
	Absolute Frequency/Percentage of Stone Industry		
Az.Z:11:5	136/80	3/2	30/18
Az.Z:14:21a	12/57	3/0	9/43
Az.Z:14:21b	33/90	2/5	2/5
Az.Z:14:21c	3,752/94	40/1	195/5
Az.Z:14:28a	70/84	3/4	10/12
Az.Z:14:28b	188/94	7/4	4/2
Az.Z:14:30	1,210/95	20/2	35/3
Az.Z:14:32	4,987/89	211/3	454/8
Az.Z:14:33a	4,704/92	160/3	244/5
Az.Z:14:33b	556/87	42/7	37/6
Az.Z:14:33c	740/74	64/6	200/20
Az.Z:14:43	240/73	61/19	27/8
Son.C:2:15	842/89	8/9	100/11
Son.C:2:22a	226/94	8/3	7/3
Son.C:2:22b	229/81	32/11	24/8
Son.C:2:25	77/79	9/9	11/11

Table 9 STAGES OF MANUFACTURE
(Percent composition of assemblage)

Site	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	TOTAL (No.)
SURFACE							
Az.Z:14:21a	14	7	43	36			14
Az.Z:14:21b	7	35	15	43			35
Az.Z:14:21c	6	18	33	33	9	1	232
Az.Z:14:28a			20	80			35
Az.Z:14:28b	2	6	12	80			173
Az.Z:14:30	2	6	10	82			411
Az.Z:14:32	4	10	15	66	4	1	5,188
Az.Z:14:33a	10	17	35	31	7	1	482
Az.Z:14:33b	8	12	21	59			529
Az.Z:14:33c	15	22	26	26	10	1	868
Az.Z:14:43	9	7	7	77			205
Son.C:2:22a	4	9	13	67	4	3	165
Son.C:2:22b	15	16	26	33	8	2	247
Son.C:2:25	32	48	16	2	2		44
SUBSURFACE							
Az.Z:14:21c	2	8	10	80			3,418
Az.Z:14:28a	6	6	10	78			173
Az.Z:14:28b				100			12
Az.Z:14:30	3	14	15	65	3		833
Az.Z:14:33a	3	12	13	68	3	1	4,426
Az.Z:14:33b		9	7	84			70
Az.Z:14:43		2		98			49
Son.C:2:15				100			30
Son.C:2:22a	6	6	15	65	7	1	72
Son.C:2:22b	9	8	9	65	6	3	98
Son.C:2:25	8	19	16	51	2	4	51

1. - Cores

2. - Cortical and cortex removal flakes

3. - Primary flakes

4. - Secondary and secondary cortex removal flakes

5. - Bifacial thinning flakes

6. - Shatter

reflects local preferences, functional requirements or propinquity is not known. However, the percentage of fine-textured crystalline rocks increased at our more southern sites, like Az:Z:14:43.

Robert T. O'Haire of the Arizona Bureau of Mines identified the prevalent types of stone in our core samples. To identify stone artifacts and to facilitate sorting, categories were standardized and simplified. A consistent nomenclature was considered of primary importance for our chipped stone categories. With the exception of a green rhyolite which was initially misidentified as a quartzite, the material names used throughout our analysis were in accord with O'Haire's petrologic identification. The following types of rock appeared in the inventory:

Igneous:	rhyolite, andesite, felsite, trap, basalt, porphyry, obsidian, pitchstone, granite, diabase and diorite.
Sedimentary:	sandstone, silicious mud to claystone, argillite, limestone, orthoquartzite and the cryptocrystalline silicate group.
Metamorphic:	metaquarzite and micaceous schist.

Most rocks were successfully identified. Two general categories were used for different igneous rocks. Felsite referred to light-colored igneous rocks which were not easily placed into rhyolite or andesite groups, while trap was used for darker igneous rocks which could have been andesites, basalts or diabases.

Rocks types were distinguished by the degree of crystallinity and the grain size. Among the igneous rocks, two vitreous textures were recognized as obsidian and pitchstone; the latter has an angular (pitched) structure. Microcrystalline igneous rocks were represented by three categories: rhyolite, andesite and basalt. Rhyolite was the most easily sorted of the microcrystallines, because it has a somewhat vitreous structure and is generally a distinctive light beige to grey. Separating andesite from basalt was more difficult; color and phenocrysts were the principal criteria used.

Much of the igneous debitage was porphyritic. The Travis (1955: 9) convention for naming the granite to rhyolite series was maintained. Predominantly porphyries have aphanitic groundmass texture and were classified as either porphyritic rhyolite, andesite (under 12% phenocrysts) or rhyolite porphyry (12 to 50% phenocrysts). Phaneritic rocks, either granite or diorite, composed an insignificant percentage of the debitage. Although the diorite has abundant plagioclase, it was still difficult to separate from the granite if the flake was small.

Sedimentary rocks in the debitage sample were primarily crystalline, most commonly from the group of cryptocrystalline silicates which includes highly workable chert, chalcedony and jasper, as well as some agate and infused clay and mudstone. Limited amounts of orthoquarzite and arkose sandstone and occasional limestone flakes were also found.

Metamorphic rocks were poorly represented in the chipped stone material. A few metaquarzite pieces and some flakes of schist, which may have been produced in manufacturing ground stone abraders and palettes, were identified.

Rhyolite was the commonest debitage, especially at all of the northern sites. Along the road at Az.Z:14:43, chert and chalcedony pieces were almost as frequent as rhyolite. At Son.C:2:14, 22 and 25, basalt prevailed.

Core Manufacture

Among the lithic remains from the Quijotoa Valley, 677 artifacts were cores (Table 3). Within this group nodular nuclei with prepared platforms predominated. Large flakes from which additional material had been removed composed 36%, of the cores, and less than 6% were exhausted cores. This suggests that storing cores for future use (curation) may have been occurring.

Fine-textured rhyolite was the material preferred for flake manufacture judging from the high percentage of cores produced from it (50%). Basalt and igneous porphyries were also extensively used. In addition all

site samples had minor constituents of cryptocrystalline silicates, impregnated clays and mudstone.

Cores from all loci shared several characteristics. Common morphologic traits, probably due to the structure of the materials available for toolmaking, included numerous multidirectional negative flake scars, abundant flake termination mistakes like hinge and step fractures, prominent bulbs of force and extensive crushing of the striking platform. Over 85% of all cores had more than five negative flake scars and were thus considerably reduced from the rough nodules initially selected for manufacture. Platform renewal was frequently necessary due to step-fracturing, hinging and platform crushing. Shatter and debris from this process were abundant in our sample.

There is a high correlation between the stone selected for cores and local rock outcrops. A majority of the landforms in the Quijotoa Valley are Tertiary and Quaternary andesitic, rhyolitic and basaltic flows. There are no known cryptocrystalline sources. From our sample it appears that some attention was given to the texture of the stone to be used. Materials with finer textures and without phenocryst were chosen most often for core manufacture. At our preceramic sites, however, coarser-textured basalts were worked with some regularity.

There is no evidence of quarrying and/or initial core reduction at any site except west of Az.Z:14:32 where a rock outcrop with numerous petrogylphs was discovered. Along the talus lay piles of large, primary basalt flakes (greater than 25 cm) and bifacially reduced cortex flakes. This quarrying and initial preparation did not extend into the right-of-way. Therefore, our artifact assemblage has only limited amounts of fine-textured tools or debitage. It is possible that the site occupation was not contemporaneous with the quarrying activities because basalt bifaces, the product of the quarrying activities, are absent from our Quijotoa Valley assemblage.

Possible manufacturing techniques can be inferred. After selecting a local rhyolite or basalt for manufacture, the "flintworker" removed the rind and did some initial shaping. This preparation occurred at the

quarry and is poorly represented in the debitage. After the cortex was trimmed, the core was imported to the base-camp or village, where large flakes were produced by hard-hammer percussion techniques. These flakes were then trimmed and retouched into tools. The primary and secondary trimming flakes, along with reused cores, are the principal constituents of our prehistoric toolkit.

Multiple flakes were removed with a percussion tool of dense igneous rock. Although the use of this hammerstone is somewhat hypothetical, in some instances the presence of such tools among the site collections confirms hard-hammer percussion with attributes like crushed platforms and distinct bulbs of force. Commonly, the base of our cores are crushed, suggesting that during manufacture the nodule rested on an anvil.

The core assemblage reflects the toolmaker's interest in the production of sturdy primary flakes useful for a variety of tasks. Most nuclei have prepared platforms (94%) to accurately place percussion blows and prevent platform collapse. This produces a more regular flake. The presence of prepared platforms also reflects quarrying techniques. The initial removing of the cortex and the shaping of the core probably took place at quarries. Thus, the cores imported to our sites already had several flake scars which became striking platforms for removal of primary flakes. The only other platform preparation was a light brushing of the surface with an abrader or hammerstone to remove projections which could have impeded proper delivery of the blow. Evidence for this procedure was the occasional appearance of small stepped flakes at the platform's edge. There were no examples of further platform preparation by either grinding or abrading.

When a core was so reduced that it was unlikely that a new platform could be prepared and additional flakes removed, it was considered exhausted. There was a very low frequency of such exhausted cores; instead, nuclei appear to have been abandoned when numerous mistakes, hinging, stepping or platform fracturing made flake production difficult. Core metrics also suggest that few cores were completely used, as over 92% of them were greater than three centimeters in length and width.

Site Description

Several sites fulfilled the criterion of minimal specimen number (30) and were submitted to statistical analysis. To compare sites cross-tabulations and frequencies were run, using two SPSS sub-programs. Although the morphology of the site assemblage was assumed to be fairly uniform, cores were not assumed to be contemporaneous. With primarily surface material, such an assumption is unwarranted. Five sites with over 30 cores each are discussed below.

Az.Z:14:28

Kokotki - Locus C: During excavation and surface collecting at this locus, 40 cores were recovered, encompassing several different types of stone. The cores were equally divided between intact and fractured specimens. A 6:4 ratio of nodular-to-flake cores was present; one in four cores was exhausted. Both prepared and unprepared platforms were observed in the sample; the latter, however, was a minor constituent (13%). Most cores had platforms with single negative flake scars (45%), although dihedral and multifaceted examples were also present. Typically a core combined two or more of the above platform types. Thus most had multi-directional orientations. The number of flake scars on the core was determined by the above features of platform preparation and directionality; 58% of all cores had six or more flake scars.

Rhyolite and igneous porphyries comprised 90% of the material employed for cores while cryptocrystalline silicates composed the remainder. No basalt or obsidian cores were present at this locus.

Both distinct and diffuse bulbs of force were noted during analysis. Equal distribution of this trait confirms the use of both dense basalt and soft decomposing granite and dacite hammerstones, which was suggested by the moderate amount of platform crushing (53% of the sample).

Az.Z:14:32

Gu Vo Waw produced a large core sample (211) within which a variety of forms, platforms and material reflected the site's mixed chronology. One hundred thirty-one whole specimens were collected. Both manufacturing and quarrying activities occurred in the vicinity; thus many cores were only partially reduced and few were exhausted.

Large nodular cores with multidirectional flaking characterized the predominately Amargosan complex at this site. Standard cores had two or more platform combinations. Most striking platforms consisted of a single flake scar or multiple interlocking scars. Distinct bulbs of force and platform crushing were common attributes of the sample, indicating that the predominant technique of manufacture was hard-hammer percussion with a dense, probably igneous, hammerstone. Hinge and step fractures were also common (87% of the sample), reflecting the use of recalcitrant basalt and igneous porphyries here, although rhyolite remains the commonly selected material overall. At the site's northern portion a minor component of cryptocrystalline silicates was recorded with a ceramic concentration. These mostly chert and chalcedony cores were smaller and more exhausted than the igenous cores.

Az.Z:14:33

All three loci at Gu Vo Hiktani produced numerous cores (226). Since the loci do not appear to be contemporaneous, the nuclei were analyzed individually. Locus A was a refuse area of a Sells phase village. It produced 35 surface and 125 excavated specimens. Here 62% of all nuclei were partial, but less than 10% were exhausted. This suggests that cores were abandoned when breakage occurred or when mistakes interfered with tool production, rather than when the stone could not be reduced further.

The platforms on all but 7% of the cores were prepared by single or multiple blows. Cores were, therefore, mostly unifaceted and multifaceted, multi-directional types. Distinct bulbs and crushed platforms indicate the predominant technique was hard-hammer percussion. Despite the minor presence of blades and elongated flakes in the tool kit, no blade cores

were observed in the collection.

Rhyolite cores constituted 78% of the assemblage, the greatest percentage of any locus. Silicious materials, andesites and porphyries were minor components. No basalt cores were present.

Locus B at Az.Z:14:33 produced 42 cores from surface grids and one from the test pits on the terrace. Twenty-five specimens were whole. Nodular and flake cores were almost equal in number. Cortical and unprepared platforms were minor constituents; instead, multidirectional unifacet and multifacet platformed nuclei predominated. Large cores, averaging 8 cm in length and having at least six flake scars, constituted the major portion of the collection (88%). Step and hinge mistakes and crushed platforms were numerous, which indicated hard-hammer percussion with a fairly dense fabricator.

There was a smaller percentage of rhyolites at Locus B than at Locus A, with a corresponding increase in the percentage of cryptocrystalline silicates. Basalts and porphyries made up the remainder of the sample.

At Locus C several preform bifaces of probable late paleo-Indian and San Pedro-Amargosan affiliation were found. There was also a small amount of pottery from a separate time period. Thus, the surface material represents at least two artifact complexes. The majority were whole nodular cores, but partial nodular and flake cores were also present. Stones with one or two unifaceted, multi-directional surfaces formed a second core type. Bulbs of force were generally distinct, but platform crushing was not as frequent here as at other loci. This suggests the use of diverse percussion instruments.

Sixty percent of the cores were smaller than 8 cm long because of increased use of cryptocrystalline silicate and other silicious stones which are found as small cobbles. Rhyolite was most common in the sample (44%), followed by basalt (25%) and porphyries (13%).

<u>Son.C:22:15</u>

Totoni had numerous heavily oxidized unifacially reduced cobbles and flakes. The cores associated with these remains are distinctive. Of the

61 specimens, 75% were large nodular nuclei with multiple flake scars (87% of them having more than six). The high occurrence of cortical and planar platforms contrasted markedly to all other sites. The latter characterize only cores from this probable San Dieguito or Early Amargosa locus. "Planar platform" refers to the use of a natural break or cleavage surface as the striking platform and constituted 44% of all platforms. The typical core, therefore, had at least one unprepared striking platform, and many nuclei had more than one.

Multi-directional specimens with numerous step and hinge fractures were evident, as were crushed platforms and distinct bulbs of force. All these features suggest percussion with a dense hammerstone. Although 50% of the nuclei were less than 8 cm long, the other lengths ranged up to 24 cm, and over 15% exceeded 16 cm.

Totoni appears to have two separate loci, one being a ceramic period activity area and the other a terrace where a San Dieguito campsite existed. The core material reflects this dichotomy as the former area produced predominantly cryptocrystalline artifacts (26% of total assemblage) while the latter had primarily basalts (25%), andesites (5%) and porphyries. Rhyolites were present in moderate amounts at both loci (30%).

<u>Core Typology</u>

There are several ways of typing cores, for instance, by formal attributes of shape. With the Papago Roads sample, however, the problem of ascertaining the contemporaneity of any given sample made it difficult to use shape and size criteria. Further, no previous core descriptions were present for the Papagueria, compounding typological difficulties. It was decided that morphological traits would produce a more useful, descriptive typology.

Two prominent core technological attributes, direction of flaking and platform preparation, were selected as variables for analysis. An SPSS sub-program, cross-tabs, was used to produce a matrix with three values of

flaking direction and 13 values of platform preparation (Appendix XI). From these two variables 30 possible core types were hypothesized.

However, the core distribution in this matrix suggested that distinct categories were not clearly visible. The prominence of multi-directional flaking techniques as well as the mixed surface contexts explains this diversity. Nevertheless, multi-directional cores with unifaceted platforms or a combination of unifaceted and cortical platforms predominated; 62% of all multidirectional cores had at least one unifaceted platform.

Since four core types were present with some regularity at most sites, they, therefore, constitute our major core types (Table 10). These were (1) unifaceted bidirectional (10% of the sample), (2) unifaceted multidirectional (30%), (3) multifaceted multidirectional (5%), and (4) multidirectional with both unifaceted and multifaceted platforms (4%).

Site Comparisons

When the specimen attributes are compared by cross-tabulations and trait percentages (Table 10), the major core-producing loci demonstrate the presence of two contrasting industries, ceramic and aceramic. Ceramic loci have almost equal numbers of flake and nodular cores. Their predominate technologic traits include a high percentage of unifaceted and multifaceted platforms with flakes being struck multidirectionally. Fine-texured rhyolites and cryptocrystalline stones are common.

In contrast, aceramic loci have greater percentages of coarse textured porphyries and basalts as well as rhyolites. At Az.Z:14:32 and Son.C:22:15, unprepared and unifaceted platforms also increase. This morphology possibly indicates less interest in pre-shaping the nuclei and in predetermining the shape of flake produced. Differing strength and task requirements for the tools being manufactured may be reasons for these dissimilar core attributes.

Chipped Stone Tools

Fourteen hundred fifty-eight (1,458) chipped stone artifacts were identified as tools by the presence of damage or polish along their

Table 10 CO-OCCURRENCE OF DIRECTION OF FLAKING AND PLATFORM PREPARATION

Absolute Frequency/Percent of Total Industry

	Unidirectional	Bidirectional	Multidirectional	TOTAL
1. Cortical	13/2	11/2	13/2	37/6
2. Planar	1/0	0/0	0/0	1/0
3. Unifacet	23/3	63/10	201/30	287/43
4. Dyhedral	2/0	1/0	4/1	7/1
5. Multifacet	3/0	16/2	31/5	50/7
6. 1, 3, 4	0/0	3/0	25/4	28/4
7. 1, 3	1/0	21/3	104/15	126/18
8. 3, 4	1/0	16/2	72/10	89/12
9. 3, 5	0/0	4/1	31/4	35/5
10. Further combinations of above	0/0	1/0	25/4	26/4
TOTAL	44/5	136/20	506/75	686/100

perimeters or by the preparation involved in their manufacture. Inspection of wear was both macroscopic and microscopic. A final determination of use was made with a 30-power microscope. This process, however, provided no assurance that all tools were identified, as many stone pieces do not display evidence of their use, having been abandoned prior to the development of a wear pattern (Brose 1975).

The complete tool assemblage from the Quijotoa Valley represents a technological adaptation to the problems of percussing non-conchoidally fracturing rock. The tools are primarily produced on flakes and display little uniformity in size and shape. Because of the diversity among artifacts, they were classified by morphologic traits like flake type, reduction or retouch manner, location of edge preparation, edge shape and design of the "rake" angle. Our small sample of bifaces and projectile points was also analyzed for style.

The tools were compared to artifact collections from regional sites, with known chronological contexts, in order to determine the prehistoric complex represented by the Quijotoa Valley sites. This comparison met with limited success. However, affiliations of some tools may be suggested.

Methods

After the chipped stone tools were separated from the debitage, they were labeled with their provenience designations and set aside for analysis. A recording sheet was developed to describe each artifact by morphologic attributes. A category like "platform preparation" was considered to be a variable with several attribute values of cortex, flake scarring, or abrasion. Platform preparation variables were described along with material; type of flake or core; surface alteration, reduction or retouch; type of edge and the location of wear. Additionally, size and rake angle were measured in ranges of 10 centimeters and .05 degrees (Appendix XI).

The tool descriptions were transferred to Fortran coding sheets by assigning numerical designations to each attribute of a variable. This data was then punched onto computer cards. Using the SPSS program,

Table 11 UTILIZED CHIPPED STONE

(Absolute Frequency/Percent of site assemblage)

SITE	#/%
Az.Z:11:5	30/.7
Az.Z;14:21A	9/3
Az.Z:14:21B	2/.9
Az.Z:14:21C	195/1
Az.Z:14:28A	10/.9
Az.Z:14:28B	4/.4
Az.Z:14:30	35/.1
Az.Z:14:32	454/.2
Az.Z:14:33A	244/2
Az.Z:14:33B	37/6
Az.Z:14:33C	200/18
Az.Z:14:43	27/2
Son.C:2:15	100/10
Son.C:2:22A	7/2
Son.C:2:22B	24/6
Son.C:2:25	11/6
TOTAL	1,389

frequency calculations were compiled for attributes within site samples and among all sites (Table 11). Other data were derived by cross-tabulating variable sets to review single variables and their relationships and to determine if attributes were recurring in significant numbers. This aided in developing the tool typologies and comparing the site's tool kits. Finally, replication studies were performed on the bifaces and points.

Material

In the Quijotoa Valley volcanic hills and outcrops provide the most extensive sources of stone for aboriginal tool manufacture. Artifacts were primarily manufactured from locally prevalent rhyolite, basalt and igneous porphyries. Exposures of granites and schists also occasionally provided material for flintworking. Contained within rhyolite tuffs are small pockets of chert, the only sedimentary rock available for tool making. Obsidian is also rare, appearing only in the form of small "Apache Tears" contained in alluvial gravels.

The limited availability of fine-textured stone meant that the aboriginal toolmaker dealt primarily with non-conchoidally fracturing material. Often these local rhyolites and basalts were non-vitreous porphyritics containing phenocrysts, which further complicated tool production. Such igneous material lacks flexibility. Crabtree (1972: 5) described it as "not fracturing smoothly and having a tendency to crumble from applied force." Unless rhyolite and basalt is unusually fine-grained, it fractures perversely when percussion flaked. Because of its toughness, it is also difficult to pressure flake. In our tool assemblage the irregular tool shapes, breakage and angularly terminated flakes are probably results of the igneous material's difficult workability. Even when easily worked chert and obsidian can be found, their small size prohibits the use of sophisticated reduction and shaping techniques. Still, the most refined work occurs on small chert and obsidian tools.

Although local sources of stone were difficult to flake, it is notable that no attempts were made to improve its quality. Crabtree (1973)

recorded the presence of heat-treated quartzites and cherts among Riverine Hohokam artifacts. Their desert neighbors in the Papagueria, however, did not apply this technique, nor does it appear that better quality stone was obtained through trading.

Tool Typology

Typologies are designed to answer specific questions about similarities and differences among artifacts. Does variation occur because of spatial or temporal differences or because of tool uses and cultural preferences? The Papago Project attempted to classify artifacts by techniques of tool production and use. The purpose of our typology was to answer cultural chronology and function questions by applying the tool typology to individual site samples.

Two assumptions underlie our classification. First, a tool's method of manufacture was considered to be culturally specific — each society made tools in a distinct manner. Second, it was assumed that the associations of tools by their methods of manufacture would suggest site activities. The typology did not, however, provide associations for interpreting cultural distinctness. This was due to the overlapping of use variables. Tools appeared to be primarily either unshaped, utilized flakes or multipurpose tools. Questions about site activities, therefore, remain unanswered if the data on chipped stone artifacts are used without reference to their context.

Our typology reflects manufacturing categories rather than functional ones, not only because of the multiple use attributes discussed above but also because of the material used in tool production. Wear pattern studies attempted during laboratory analysis proved unsuccessful in establishing separate, distinct, microwear patterns related to tool use. Therefore, while agreeing with Tringham's statement (Tringham and others 1974: 173)

> variation of their (artifacts') macromorphological attributes along (specifically retouch and method of manufacture) is not nearly such a significant manifestation of cultural variation as when combined with attributes which indicate how the artifact was used,

Table 12 THE OCCURRENCE OF STONE TOOL TYPES AT ALL SITES

(Absolute frequency/Percent of total assemblage)

	Utilized	Unifacial Retouch	Bifacial Retouch	Other
	#/%	#/%	#/%	#/%
Worked Stone	27/2	46/3	29/2	102/7
Nodule	57/4	36/2	2/0	95/6
Flake-Core	24/2	828/2	3/0	55/4
Cortical Flake Cortex	22/1	77/5	4/1	105/7
Removal Cortex Flake	77/5	128/9	6/1	211/15
Primary Flake	255/17	385/26	48/4	686/47
Secondary Flake	59/4	55/4	12/1	126/9
Secondary Cortex Removal Flake	11/1	19/1		31/2
Other	17/1	26/2	4/0	47/3
TOTAL	547/37	800/54	108/9	1,458/100%

their methods are not applicable to the Quijotoa Valley artifacts.

The initial categorization of stone referred to the rock portion used for manufacture. A tool can be produced by percussing a rough block (worked stone) or by shaping a cobble or nodule and then removing fractured pieces (a core and its flakes). Further, stone can be used without any percussion work at all (a utilized stone). Distinctions among these categories are not rigid. In particular, whether a stone was used solely to make flakes or whether it was shaped and its residual debitage went unused is a subjective point. Therefore, each artifact was studied to determine what features were present. If a nodule had few large flake scars, showed little evidence of careful attention to platform preparation and had a sinuous platform edge, it was classed as worked stone rather than as a core. Direction of flaking and condition of the platform were likewise assessed for the presence of technical features. A flake was sorted from a utilized piece of unworked stone by its bulbs of force, striations, radii and striking platforms (Crabtree 1972; Tixier 1974). Within these broad groups, tools were divided by whether they were simply used or were flaked to shape or sharpen them.

Tools on Cores. A core is any nodule, cobble or large rock fragment which has been reduced and shaped to produce usable laminae. The manufacture may stop with the core or alternatively recycle it for a second use. Rounding, polishing or battering of a utilized core's platform edge characterize a tool. Removal of small overlapping flakes to sharpen, straighten and strengthen the core edge, percussion flaking, pressure flaking and notching were techniques applied to our cores to make tools.

Three types of core tools occur in the Papago Road sample. These are (1) utilized cores, (2) retouched cores and (3) notched cores. The most common tool form is a unidirectional core with a prepared planar platform. Often described as "scraping planes," "pulping planes" or "kartans," these tools show worn platforms and extensive nibbling (tiny disparate step-fractures) along their periphery. Kowta (1969) suggested that these cores were used to process agave.

A second core tool type is a bidirectional core which had been reused as a "chopping tool." These cores display extensive dulling and battering at the intersection of two planes. Although somewhat less common than unidirectional core tools, small amounts of these bidirectional cores occurred at Son.C:2:15 and Az.Z:14:32.

Tools on Flakes. Tixier (1974: 14) describes a flake as an intentionally detached piece of rock displaying features associated with the Hertzian cone of force. Such stone fragments we sorted by their manufacture attributes. We then hypothesized a system of tool production in order to categorize our flakes as cortical, cortex removal, primary, specialized primary, secondary, secondary cortex removal and shatter. Each category was reevaluated to identify further flake modifications like mass reduction, unifacial or bifacial, on the bulbar or outer face, edge alteration and configuration.

Initial tool sorting by manufacturing stages isolated certain flake types. For instance, a cortical flake is often bi-convex, while a primary flake may be plano-convex or even concave-convex. Profiles contributed to the suitability of one flake over another for certain tasks. After this first classification flake size, thickness and profile were evaluated unarbitrarily. Multiple ways of variation were thus assessed.

After sorting by category, edge modification was evaluated. Only utilized flake tools were separated from those whose edge angles had been changed, sharpened, and/or strengthened by retouching. Flake manufacture and edge modification developed a matrix of 28 types. However, six hypothesized types were unrepresented in our sample, while eleven were underrepresented (less than 1% of our total tool sample). The following tool types were established (Table 13): utilized flakes, (1) cortical, (2) cortex removal, (3) primary, (4) secondary; unifacially retouched flakes, (1) cortical, (2) cortex removal, (3) primary, (4) secondary and (5) secondary cortical and bifacially retouched primary flakes. Table 12 records the number and percent in each tool category.

In proposing this simple typology, it is recognized that a more complete taxonomy could be designed. Further divisions are recognizable in our chipped stone sample. For example, whether a flake has been unifacially or bifacially reduced by percussion flaking crosscuts categories of core and flake tools. Projectile points and other bifaces are obvious examples of the overlapping of taxonomic categories in a single functional type. Therefore, a separate analysis was reserved for bifaces.

Worked Stone. Worked stone is the third category of material. These artifacts do not display the core's systematic flake production, instead they are often cobbles with several flake scars. Here percussion work was directed toward producing a sharp cutting edge. Flaking either involved the removal of several large flakes to produce the unifaces often called "choppers" or simply involved percussing the edge of a tabular basalt piece to make a serrate.

Three prominent worked stone artifact types are identified: (1) unifaces (choppers), (2) bifaces (chopping tools) and (3) worked tabular pieces ("mescal knives"). Worked stone unifaces comprised 1% of the total tool assemblage while bifaces comprised 2%.

Only ten pieces of stone were unclassifiable. These were unshaped utilized rock which did not fit the categories of hammerstone or handstones and showed evidence of retouch, either accidental or deliberate.

Bifaces. A final typological category is the biface, a systematically reduced and shaped core or flake. Bifaces often function as knives or projectile points. A separate typology based on stylistic attributes was developed to describe these tools. When possible, styles in our sample were compared to known point types in order to facilitate the relative dating of sites.

Discussion. The basic elements of our typology are flake type and edge; both appear to be distinctly distributed. Other factors often considered, like the angle of the tool's edge (rake angle), are controlled by these

elements (Wilmsen: 1970). When edge angles were measured, the measurements varied according to material, retouched edges (wider angles) and cortical, primary or secondary (decreasing angle size) flakes. Therefore, this attribute was discarded from our tool classification as being too indistinct. The same was true for retouch. Such variation does not clarify what factors control edge angles; if both unretouched and retouched are compared, their means do not differ significantly because extreme values skew distribution.

Projectile Points and Bifaces

All bifacially reduced specimens and all flakes with bifacially worked bases were analyzed separately to identify types and chronologic affiliation. Seventy-two whole and 65 broken pieces of projectile points, preforms and bifaces constituted our sample. Sixty-two projectile points were sorted from the collection; 55 of these were typed (Table 14) into 24 categories (Fig. 40a, b).

Few sites produced more than two or three projectile point artifacts, either incomplete, partial or finished. Although Az.Z:14:32 had 45 examples and Az.Z:14:33 had 64, chronologic placement of the material varied widely. At these two sites, points were identified that possibly date from paleo-Indian through Amargosa to Hohokam and Papago times.

Since there are so few of these tools, a separate typology for each site was not necessary. Similarly bifaces and points are described morphologically. Nevertheless, during analysis, two groups of artifacts consistently shared features associated with point manufacture: (1) bifacially reduced cores and primary flakes and (2) notched primary flakes. These were reexamined and are individually described.

Typology

Categories of points and other bifaces are always difficult to establish because of the necessity for making a series of decisions about their style and condition when recovered. All too often, bifaces which were

Table 13 TOOL TYPE OCCURRENCES AT MAJOR LOCI

(Absolute Frequency/Percent of site assemblage)

	Az.Z:14:21C	14:32	14:33A	14:33C	Son.C:2:15
Worked Stone	6/4	28/6	16/7	14/7	20/20
Utilized Core	11/5	26/6	7/3	8/4	6/6
Retouched Core	9/5	26/6	11/5	6/3	6/6
Utilized Cortical Flake	4/2	5/1	3/1	3/1	2/2
Retouched Cortical Flake	6/3	24/5	15/6	16/8	6/6
Utilized Cortex Removal Flake	20/10	17/4	12/5	16/8	2/2
Retouched Cortex Removal Flake	19/10	51/11	20/8	19/10	8/8
Utilized Primary Flake	35/18	85/19	35/15	37/19	19/19
Unifacially Retouched Primary Flake	46/23	139/31	60/24	56/28	17/17
Bifacially Retouched Primary Flake	1/1	15/3	14/6	6/3	4/4
Utilized Secondary Flake	15/8	10/2	18/7	8/4	2/2
Retouched Secondary Flake	17/9	16/4	24/10	9/4	6/6
Other	3/1	2/0	6/3	3/1	2/2
TOTAL	185	454	244	200	100

Table 14

IDENTIFIED POINTS AND THEIR PROVENIENCES

TYPE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Unknown
Az.Z:11:5																	1								
Az.Z:14:21																						1			
Az.Z:14:28		1												1			1								1
Az.Z:14:30								1			1			1						1					
Az.Z:14:32			2	3			1			2	1	1													1
Az.Z:14:33	5		7			1				1			1		1	2		1	3	1	4				1
Az.Z:14:34									1																
Az.Z:14:42			1																						
Az.Z:14:43																							1		1
Son.C:2:12																			1						
Son.C:2:15	1									1														1	
Son.C:2:20					1																				
Son.C:2:22														1											
TOTALS	6	1	10	3	1	1	1	1	1	4	2	1	1	3	1	2	2	1	4	2	4	1	1	1	4

abandoned due to a mistake or were broken during manufacture are inadvertently included in the point and biface typology. The ability to recognize complete or preliminary attempts at reduction, even for the most sophisticated flintknapper, depends upon a knowledge of all possible point styles from a given area and an awareness of postdepositional activities which might erode and alter the tool's surface.

Papaguerian point styles are known primarily from Ventana Cave. Using these as a guide, models of manufacture may be established for each known type, and preforms of certain styles can perhaps be identified. Figure 42 includes the point and biface types from the Papago Project sample which were large enough for illustration.

Type 1: A biface thinned by softhammer percussion. Probably two varieties of this type are present, slightly concave and slightly convex based points. Specimens are made from rhyolites and basalts and have a projected size of 8-10 cm. All have snapped transversely during manufacture, either from impact shocks or misdirected blows. No basal thinning, fluting or grinding was observed. With one exception, the bifaces show moderate oxidation. All are from surface contexts. Their affiliations appear to be with either late paleo-Indian (San Dieguito III) or early Desert Archaic (Amargosa) complexes because of the manufacturing techniques.

Type 2: Straight-stemmed biface. This point was manufactured from coarse-textured rhyolite by hard-hammer percussion on a thick flake. The specimen is 5.5 cm long. The sole example is from the surface at Az.Z:14:28. A similar point type is found at Ventana Cave in the Ventana-Amaragosa I levels.

Type 3: An expanding shaft, hard-hammer, corner-notched point. These average 5 cm in length and are manufactured by hard-hammer percussion from large basalt, rhyolite or chert flakes. Retouching was done to straighten and align the base and tip. They were notched by hard-hammer percussion. Haury referred to this point as the expanding straight type and attributed

it to the San Pedro-Amargosa II Complex. These points were found on the surface, primarily at Az.Z:14:33.

Type 4: A serrated, stemmed bifacial point with corner-notching. The projected length of the point is about 8 cm. It is commonly made from fine-textured rhyolite. This point was produced by bifacially thinning a large flake with a softhammer (baton). Serration was accomplished by bifacial pressure notching; however, corner-notching appears to have been with a percussion blow. This point is often assigned to San Pedro-Amargosa II complexes.

Type 5: A small leaf-shaped biface. There is only one specimen which is 5 cm long and made from a rhyolite flake. Some hard-hammer percussion work is visible although pressure retouch on the edges has obscured earlier scars. No affiliation can be suggested for this type. Although found at Son.C:2:20 (a late roasting pit-activity area), it does not appear to be associated with recent ceramic horizons. It is somewhat similar to a Chiricahua point from the Fairchild Site, southeastern Arizona (Windmiller 1973b).

Type 6: A side- and basally notched point. A single specimen was identified, 3.5 cm long and fabricated from fine-textured basalt. Percussion work with a hardhammer apparently was used for reducing and notching the flake. The point type was encountered in the Amargosan levels at Ventana (Haury 1950: 291). It is also common in the Pinto material from the California desert area and Chiricahua stage material from southeastern Arizona. It was found on the surface at Az.Z:14:33.

Type 7: A triangular side-notched point with lateral serrating at its tip. It is 3.2 cm long and manufactured from basalt. Hard-hammer percussion reduced the flake, but pressure work was used in notching and serrating the point. Haury (1590: 277) referred to these straight-based types as probably having Amargosa II affiliations. The single specimen came from Az.Z:14:32.

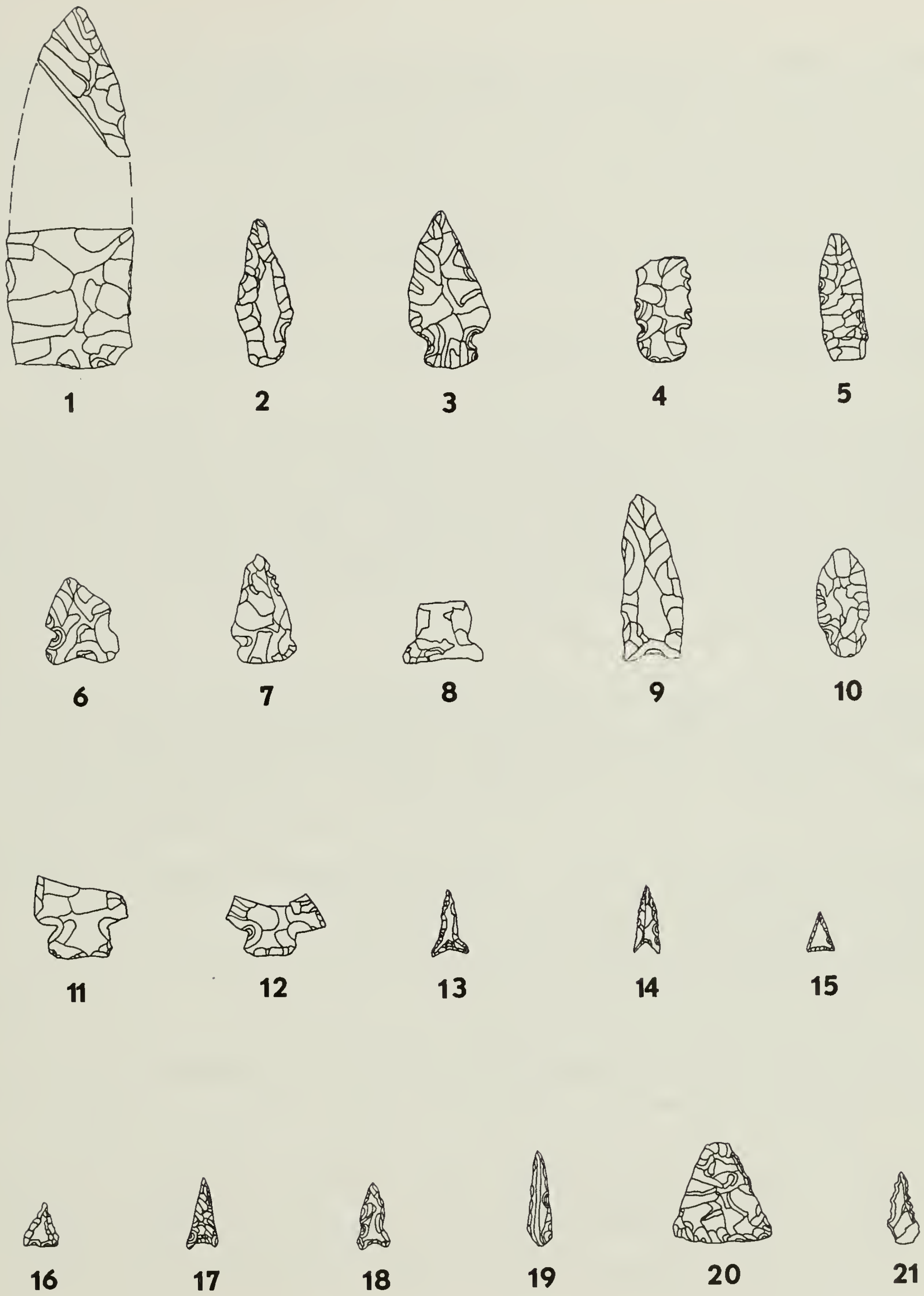


Figure 42. Projectile point types.

Type 8: A small biface which is tanged. Its estimated length is 3 to 4 cm. This point was made on a basalt flake by hard-hammer percussion. The tang was produced by notching with a pressure tool and by percussion. Haury placed similar points in the Pinto-Amargosa II period. Since this point is not found within the descriptions of Pinto material (Harrington 1957), its probable affiliation is Amargosa II (post-Pinto).

Type 9: A semi-triangular, elongated biface with a concave base. This point is about 3 cm long and was made from basalt. The single specimen was produced on a flake by hard-hammer percussion. The concave base is formed by bifacially notching with a hard-hammer blow. Points somewhat similar to this type were found in the lower levels of the wet midden at Ventana Cave (Haury 1950: 277). They probably date to Amargosan I times. This point was found on the surface at Az.Z:14:34, a lithic scatter south of Gu Vo Village.

Type 10: Points which have rounded tapering midsections and tips and are convex to straight at the base. Small side-notches are present. Three examples, averaging 3 to 3.5 cm long, are made from fine-textured basalt, rhyolite and chert. The points are made on flakes by hard-hammer percussion and are stemmed by notching (probably by pressure flaking). Haury attributed these points to Amargosa II or Gypsum periods. They also appear to resemble the somewhat earlier Silver Lake points from the southern Great Basin (Harrington 1957: 55).

Type 11: Sharply sided triangular points with corner-notching and straight bases. Because only bases were recovered, the total length of these points is unknown. They are manufactured from rhyolite, chert and chalcedony flakes. Apparently soft-hammer percussion was used to thin the bifaces and a pressure notcher was used to form the base. These appear to date from the late preceramic to early ceramic time periods (Haury 1976: personal communication).

Type 12: Corner-notched, stemmed point. This small base is of chalcedony. It has large corner notches and has been finished by parallel oblique pressure flaking. It is probably an early ceramic period point.

Type 13: Tanged, concave-based point. This small arrowhead is about 2 cm long and is manufactured from chert and obsidian. A secondary flake was bifacially worked by the pressure technique to thin and shape the point. This point is associated with Tanque Verde ceramics at Az.Z:14:33.

Type 14: Serrated, concave-based point. This is a small arrowhead made from either chalcedony or obsidian; average length is 2 cm. A secondary flake was bifacially pressure flaked, and small lateral bifacial notching serrates the point. The concave base was produced by a large bifacial pressure notch. This point type is unmentioned in the Ventana Cave Report but may date to Proto-historic or Historic times. Alternatively, it has been suggested that serrated points antedate the Sells phase (Huckell 1975: personal communication; Zahniser 1966). Both examples are from surface provenieces at late Tanque Verde (Az.Z:14:33) to early Papago (Son.C:2:22) sites.

Type 15: Triangular concave-based point. This small triangular arrowhead is less than 1.5 cm long and made from either chert or obsidian. A secondary flake is bifacially pressure retouched, primarily along its edge, to shape the point. This point has been identified as Historic Papago, the "Batki" point (Haury's "triangular concave," 1950: 297). At our sites, however, it has only been identified in assoication with middle to late Tanque Verde ceramics.

Type 16: Notched concave-based triangular point. This squat arrowhead is only 1.5 cm long and manufactured from both obsidian and chert. A secondary flake was unifacially reduced by pressure flaking. Two notches isolate a basal knob. The lateral edges undulate in a possible attempt to serrate the point. The two examples from the upper level and surface at

Az.Z:14:33 are probably either Protohistoric or Historic points.

Type 17: Triangular concave-based, unserrated. This small chalcedony arrowhead is only 2 cm long. It is similar to type 14, but lacks the lateral serration. A flake was bifacially pressure flaked to produce this point. It was found in the pit house fill at Az.Z:11:5 and should be considered a Tanque Verde related point style. An obsidian base of this type was recovered from Az.Z:14:28.

Type 18: Triangular, concave, laterally-notched point. A small arrowhead, this point is about 2 cm long and was produced on either chert or obsidian. A secondary flake was bifacially pressure flaked to thin and shape the point. A pressure tool was employed when making the lateral and basal notches. The examples of this point style are all associated with Tanque Verde ceramics.

Type 19: Bladelet point. This small point type averages 3 cm in length and was made from chert or rhyolite. A blade was bifacially retouched by pressure flaking to straighten and point it. A single specimen comes from a deep unit at Az.Z:14:33 and was associated with Tanque Verde ceramics. Similar bladelets have been found at the Potrero Site in the Santa Cruz Valley (Grebinger 1971b: 38).

Type 20: Triangular convex biface. This biface type was presented by a single chert specimen 3.5 cm long and it was bifacially reduced, possibly with a soft-hammer baton. The edges were then bifacially pressure flaked. The biface was found within the midden area at Az.Z:14:33, at a depth of 40-50 cm, and probably dates to the Sells phase.

Type 21: Serrate ovoid point. This is a small flake point, 2 cm long and made from rhyolite. Small secondary flakes were bifacially serrated to produce this type. No other attempt was made to shape the point. Specimens were recovered from Az.Z:14:33.

Type 22: Large triangular point with concave base. This point is approximately 3.8 cm long and made on a chert flake which has calcedony phenocrysts. It is reduced by hard-hammer percussion. The slight basal concavity was formed with unifacial hard-hammer notch. Its chronologic affiliation is unknown. It was found in a surface context at Az.Z:14:43 which is primarily a Sand Papago site. (Not illustrated.)

Type 23: Triangular stemmed biface. This basalt specimen is 4.5 cm long. A primary flake was reduced by hard-hammer percussion to form the tip and stem. The edges were retouched, possibly by pressure flaking. The single specimen comes from Son.C:2:15. It is probably datable to Amargosan times. (Not illustrated.)

Summary

There are quantitative differences among tool types at the Quijotoa Valley sites. Certain tool categories occur more frequently at aceramic than at ceramic loci. Morphological distinctions can be recognized in the core and debitage assemblages which indicate site and chronological patterns of tool manufacture.

Three aceramic loci were identified as belonging to the Desert Archaic Amargosa or earlier complexes. These were Az.Z:14:32, Az.Z:14:33 (Locus B and a part of Locus C) and Son.C:2:15. How do these sites differ technologically from later Sells phase and Sand Papago sites?

The Son.C:2:15 site is markedly different from all other sites. It has the highest percentage of basalt tools, debitage and cores. As mentioned previously, the unprepared planar core technique separates the technologic tradition of this site from all the others. In addition, worked nodules and cores comprise over 30% of the assemblage. Only 34% of the material appears used, and retouching is uncommon. Although this percentage of retouch is similar to other sites, the technique is exclusively hard-hammer. Often retouching takes the form of notching. The character of the industry becomes even more pronounced if the heavily oxidized tools

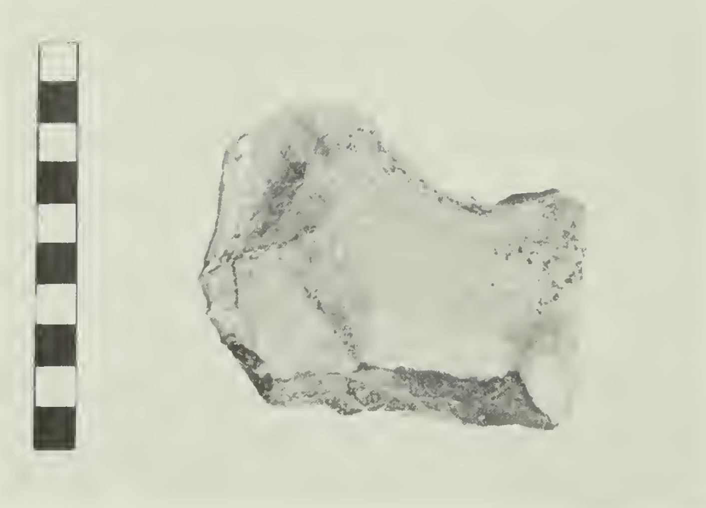


Figure 43. a. "Two generation" tool, Sonora C:2:14.

Figure 43. b. Oxidized tools or flakes or tabular pieces with hard hammer retouch.

of this site are separated from the small unaltered chert pieces. In essence, the predominant occupational debris is large unifacially and bifacially reduced cobbles ("chopper-chopping tools"), battered cores and notched flakes. Portions of the tool kit are illustrated in Figure 43a, b. Points from Son.C:2:15 are datable to Amargosan times.

On either side of Gu Vo Wash are a series of dissected terraces. To the north lies Az.Z:14:32, an extensive activity area with stone circles, bedrock mortars and concentrated lithic scatters. Occasionally late sherds can be found, but points from this site are identifiably San Pedro-Amargosa II. They are the serrate form (Type 4) and are found in association with a number of bifaces and possible preforms. The tool complex from this site is quite similar to that reported by Haury for the wet midden at Ventana Cave. The most common tool forms are utilized and retouched large primary flakes which show some care in their production; either unifaceted or multifaceted platforms are prepared on flakes, cores and tools.

Although worked stone was not particularly common, the percentage of utilized and retouched cores was higher here than at any ceramic site (11%). We also saw frequent reduction of parent rock to make both bifacially and unifacially reduced flake tools. More attention to the tool shape and rake angle, frequent notching and serial hard-hammer retouching were all evident. Thus, the Amargosa II assemblage at Az.Z:14:32 is notable for its reduction refinements and edge preparation (Fig. 44a, b).

Az.Z:14:33, Locus B, was aceramic while Locus C had mixed Tanque Verde and earlier material. The mixing of surface material made it difficult to assign tools to one of the several different prehistoric complexes. Locus B at Az.Z:14:33 was only marginally affected by road construction, so only the site surface was collected. The 37 tools recovered are either large unreduced flakes or bifacially reduced flakes. Hard-hammer retouching was fairly common. The rhyolitic and andesitic material was lightly oxidized.

Locus C had a somewhat higher percentage of unifacially and bifacially reduced worked stone pieces, associated with several transversely fractured bifaces. An average length of 11 cm is estimated for these heavily

Figure 44. a. Unifacially reduced, retouched flakes from Arizona Z:14:32.

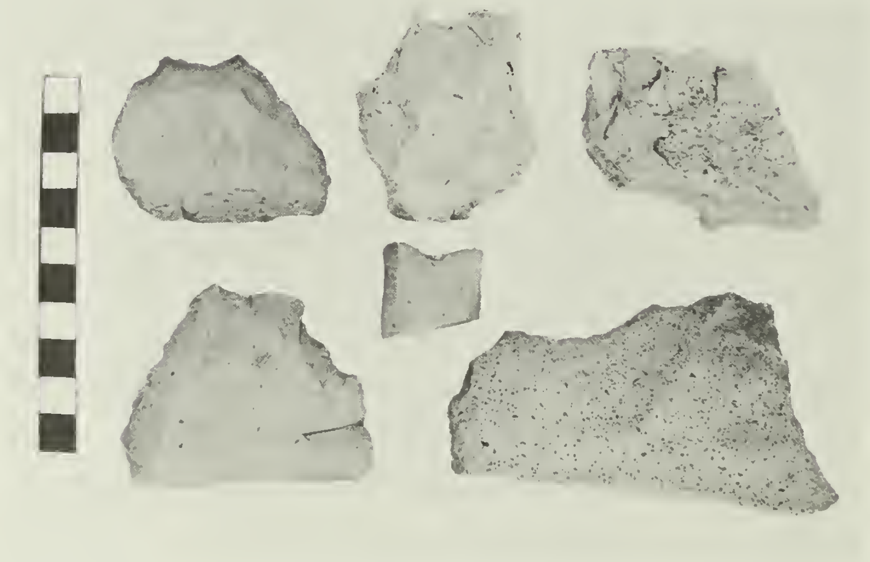


Figure 44. b. Unifacially reduced, retouched flakes from Arizona Z:14:32.

oxidized rhyolite and chert pieces. They display the technique of bifacial soft-hammer reduction typical of paleo-Indian point manufacture. The bifaces appear to have broken during manufacture, so it is difficult to assign them to paleo-Indian times because the finishing techniques of basal grinding and channel flaking are absent.

The remaining sites are all either Sells phase or Sand Papago and span the time period from around A.D. 1050 to 1800. Ceramic sites show some internal variation in point styles but are consistent in their techniques of tool manufacture. A variety of different flakes is common. Sixty to sixtyfive percent of all tools are retouched, but reduction is less frequent (48% - 50%). Size differentiates ceramic from aceramic tools. At aceramic loci, there is a greater range of metric lengths, widths, and thicknesses. At ceramic sites the average size of tools is somewhat larger, while cores are somewhat smaller.

Points at ceramic sites are also distinctive. In earlier periods, rhyolite and basalt were the most common point materials; even porphyries and occasionally cherts were used. The points associated with Tanque Verde ceramics, however, are commonly chert, chalcedony or obsidian. Uniformly small, they have concave bases and often serrated lateral edges. Historic sites have tiny, triangular, unifacially pressure-flaked points (Fig. 45a, b).

Ceramic period technology is characterized by the introduction of parallel oblique pressure flaking and serial pressure notching. Bifacial reduction is not common but pressure shaping is. A gradual evolution from worked stone and nodular core tools to primary and cortical flake retouched tools may be seen in the Quijotoa Valley. Techniques are fairly simple, with careful hard-hammer flaking during the Archaic period and pressure flaking during the Ceramic. At no time is soft-hammer percussion work common.

Three ceramic loci produced thirty or more whole tools, Az.Z:14:21 C, Az.Z:14:33 A and Az.Z:14:33 C (Table 3). Limited samples precluded identifying typical tools and reconstructing activities at other Sells and Historic phase sites. At Kokotki and Gu Vo Hiktani, however, tool complexes

were moderately large (though surface material was not all contemporaneous). Along with the manufacture techniques noted above, there was an increased use of unmodified flakes, particularly cortical, cortex removal and secondary flakes (Table 13). Although tool proveniences were reconstructed and plotted for both surface and subsurface artifacts, no association of tool types were identified. Tool frequencies decreased with depth and did not aid in locating the possible house floor or living surface at Az.Z:14:21 C.

In the Project area sites with Papago and Yuman III ceramics had few tools. Noteworthy, however, was the increased relative frequency of chert tools and debitage at these later loci. Small tools were common, but again too few in number to suggest activities or types. Further, at these sites, surface redeposition has seriously disturbed artifact distributions.

Conclusion

The material being worked undoubtedly influences the Quijotoa Valley techniques of manufacture. Tough, recalcitrant igneous stone is often worked but does not lend itself to precision pressure and soft-hammer flaking. The poor nature of the parent rock does not mean, however, that little attention is being paid to its preparation. The platform preparation, cortex removal, and block and flake reduction all reveal concern for the tool shaping. The numerous mistakes, hinges, step-fractures and crushed platforms clearly substantiate the difficulties in producing set styles of tools on poor quality lithic material.

Figure 45. a. Obsidian points - "Hohokam" to Papago Types - 14,15,22.
Top left to right - Arizona Z:14:33; Z:14:30.
Bottom left to right Arizona Z:14:33; Z:14:21,c,2;
Z; 14:30,2.

Figure 45. b. Miscellaneous Amargosa Points - Types - 2f, 8, 9, 1f, 18.
Top left to right - Arizona Z:14:43; Sonora C:2:15; C:2:16.
Bottom left to right - Arizona Z:14:34; Sonora C:2:15;
Arizona Z:14:32; Z:14:33.

GROUND STONE TOOLS

Of the 1,839 tools recovered during fieldwork in the Quijotoa Valley, 381 were either manufactured by abrasion or by use attrition. These tools have been designated ground stone artifacts because of their principal method of manufacture, grinding with an abrasive material. The local application of this technique is unsophisticated, and the finished products are simply designed.

Forty whole and 341 partial specimens constitute the total Quijotoa Valley tool complex of ground stone. From these artifacts we developed a typology based on their technologic and stylistic attributes. We compared our ground stones with contemporaneous material from other southern Arizona sites to assign standard tool appellations.

The prevalent raw materials in our sample were fine-textured and scoriaceous basalt. Other igneous rocks like rhyolite, andesite and diorite were also selected by the toolmaker. Two tool forms predominate. One is a pecked and ground ovoid handstone, principally made of igneous material. The second is an amorphous hammerstone of dense igneous or metamorphic rock. Such tools have one utilized surface, though occasionally two or more utilized areas are apparent. In general, the artifacts are not typical of those previously identified in the Papagueria, so they are dated by association.

Methods/Distributions

We grouped ground stone artifacts by a combination of technologic and stylistic attributes. A tool's geometric shape, method of manufacture, surface alteration (weathering and the like), number of used faces, types of wear, metrics and material were recorded. Tools were classified with a computerized SPSS sub-program which performed cross-tabulations by attributes. Tabulations of both site and overall frequencies were done with a separate SPSS sub-program. We plotted artifact distribution at major loci on site grid maps to identify possible activity areas.

Table 15 describes the tool types and number of specimens from several sites. Only eight sites produced sufficient material for individual artifact provenience and tool kit analysis. Major samples were recovered from Az.Z:14:32 and Az.Z:14:33. Along with the overall paucity of material, our analysis was complicated by the fact that most ground stone tools were from surface sites and many of them were broken.

Typology

Our ground stone sample contains tools which seem either deliberately shaped for specific tasks or simply selected for use. Thus, two functional classes may be recognized (1) tools used to produce other tools or ornaments and (2) tools used to process food and raw materials. The former group includes the flintworker's percussion and abrasion tools, while the latter class consists of milling stones and handstones used to prepare foods, clays and pigments. These functional classes are not mutually exclusive. Tools often had several wear patterns, suggesting multiple uses. Ground stone artifacts used to manufacture tools or ornaments included percussors and abraders.

Instruments used to grind, mash or pulverize vegetal material, clays or pigments incorporate two elements: the active (mobile) handstone and the stationary millingstone. Several types of handstones and millingstones are identified among the artifacts from the Quijotoa Valley sites.

Percussors

Twenty-one artifacts were classified as percussors. The two types of percussors in the Project's sample are hammerstones and peckingstones. Hammerstones (Fig. 46) were probably used to percussion flake lithic material. They are dense igneous rocks and appear suitable for the reduction of the typical rhyolite and basalt cores and flakes found at most of our sites. The criteria for their identification include an (1) ovoid to round shape, (2) a flattened use area with a smooth wear facet and (3) battered poles on the large specimens.

Table 15 GROUNDSTONE TOOL TYPES AT PROJECT SITES

Sites	1	2	3	4	5	6	7	8	9	10	12	13	Other	Fragments	Total
Az.Z:11:5	2	2	1	2			1		2	1			1		12
Az.Z:14:21A & B	3						1						3	2	7
Az.Z:14:21C		2	7	1	3				1				6	3	20
Az.Z:14:28	6		4		4								5	1	19
Az.Z:14:30	2	6	5		3	1							12	9	29
Az.Z:14:31										1			1		2
Az.Z:14:32	15	6	28		5		1			1	1		33	31	90
Az.Z:14:33A	9	8	19		6		2	1					37	33	82
Az.Z:14:33B	8	2	7		2								7	6	26
Az.Z:14:33C	7	3	16		2		4		1				13	10	46
Az.Z:14:43	1	1	3		1	1			1		2	1	1	1	12
Son.C:2:15	2						1						1	1	4
Son.C:2:22	6	4	6		1				1			1	5	3	24
Other	1	2					2						3	3	8
TOTALS	62	36	96	3	27	2	12	1	6	3	3	2	128	103	381

KEY:

1. Millingstone
2. Handstone
3. Mano
4. Rasp
5. Abrader
6. Mortar
7. Hammerstone
8. Pitted Stone
9. Pestle
10. Pottery Anvil
12. Mano/Handstone
13. Handstone/Pitted Stone

Other: Palette and combinations of the above tools.

Peckingstones are similar to hammerstones but are cylindrical and elongated. They have rounded and battered poles but lack the smoothed faces that characterize hammerstones. Peckingstones are percussors but are used primarily in shaping rough stone prior to grinding. Crabtree (1972:80) stated that peckingstones were probably used to form "overlapping superimposed cones" by applying force in a perpendicular direction. This technique typifies the manufacture of ground stone. Like hammerstones, peckingstones are of dense igneous material.

Abraders

Forty-two whole and partial specimens were recovered. Abraders (Fig. 47a) are granular rock tools which have grooves, rounded edges or flattened faces. Such attrition wear patterns develop in several ways. Crabtree (1974: 1) has suggested that the demonstrable patterns on abraders result from their use in "the smoothing and rounding of bases (on points) to prevent the severing of lashings and to aid in hafting; the abrading of platform surfaces to strengthen the area of applied force and aid in flake and blade removal; the grinding and polishing of one of two faces to reduce friction and drag to allow for deep cutting." Abraders encountered during the Papago Project fieldwork could have been used in biface basal grinding, in flake and core platform preparation and in the polishing of stone "hoes."

At Snaketown, Haury (1976: 284) identified a special type of abrading stone, the reamer (Fig. 47b). This tool was limited in use to "a rotary motion, for the production of large perforations." Both Haury (1976: 284) and Johnson (1960: 127) have presented contextual evidence for the use of reamers in the manufacture of shell bracelets. Such tools are numerous in the Quijotoa Valley sample. Materials used for abraders and reamers included sandstone, micaceous schist and pitchstone.

Figure 46. Miscellaneous groundstone. Top - Sandstone hammer, Arizona Z:14:21; bottom left - Hollowed bowl or mortar, Arizona Z:14:43. bottom right - Cylindrical peckingstone, Sonora C:2:25.

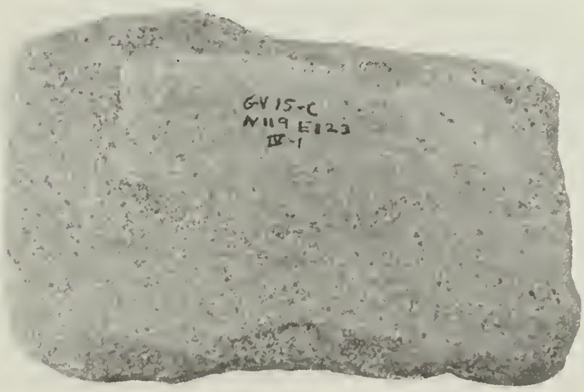
Millingstones

Millingstones include deliberately shaped ground stone pieces termed metates (Fig. 48) and utilized flattened or hollowed stones called milling surfaces or mortars.

Few metates, either whole or fragmentary, were recovered either during the survey or the excavations. Our specimens are mostly broken and reveal only cursory shaping. They have roughly shaped edges and flattened bases with a concave use area. Most metates appear to fit Haury's description (1976: 280) of "basin" types. No "trough" metates were identified despite their common occurrence in other Papaguerian sites of the ceramic period. The metate surfaces suggest that they were worn by a reciprocal motion.

a. Micaceous schist abrader, Arizona Z:14:21.

b. Palette, Arizona Z:14:32.



c. Micaceous schist reamer, Arizona Z:11:5.

Figure 47. Groundstone artifacts.

The metates and milling surfaces indicate a continuum rather than distinct types. As stone preparation decreased, the tool becomes a simple milling surface. Unshaped boulders with pecked use-areas and stationary stones with only wear and polish were typed as milling surfaces.

A final major millingstone type is the mortar (Fig. 48). Portions of small boulders were hollowed out by pecking to provide a deep well for pulverizing material. Only three mortars were collected during fieldwork, but numerous bedrock mortars were observed throughout the Project area. One mortar was of scoriaceous basalt and the remainder were of finer-textured igneous material.

Palette

A millingstone type which represents both ornamental and practical use is the palette. We recovered a small micaceous schist palette (Fig 47c) at Az.Z:14:31. Simply decorated with a narrow, etched band around its perimeter, it was a slightly convex rectangle. The center of the decorated face had a small, rounded depression which appeared to be the result of use. A piece of a possible second palette was recovered from the pit house at Az.Z:11:5.

Pitted Stone

Another basaltic artifact represented in our sample was a "pitted stone." This is a small cobble with small central depressions. Haury (1976: 278) has described similar objects as "lap stones" or anvils but implies that they became multi-pitted through use rather than through manufacture. It is doubtful that our "pitted" stones were used as anvils because the depth and width of the hollows would lead to unwanted flake termination at the contact point. Either they were used as a rest for breaking nuts, seeds and other hard objects, or as a small mortar for pulverizing pigment. The round depressions appear deliberately shaped.

Shaped and Unshaped Handstones

The active elements of the grinding and pulverizing apparatus include three tool types: handstones, manos and pestles. The differentiation between handstones and manos is based upon the difference between deliberate grinding (manos) and simple utilization or overall pecking (handstones).

Handstones are water-worn cobbles and pebbles which were selected, probably by size and density, for grinding and mashing mineral and vegetal material. As a result of such activities, they develop a distinct smooth facet. Usually one worn surface appeared on our tools, although a significant number were bifacially worn.

Haury (1976: 281-2) distinguished handstones from manos by the rounded overall shaping of the former. The handstones from the Quijotoa Valley were also rounded by pecking but lack obvious signs of grinding. One-half of all the handstones were round, but the remainder were amorphous and unshaped. Our handstone category, therefore, included both Haury's round type and amorphous active members.

In contrast manos were both rounded and rectangular, reflecting the reciprocal motion involved in their use. Manos were both pecked and abraded into shape and usually had two wear areas. The cross-section of a mano shows biconvex, smooth and/or polished use areas. Handstones were less convex in profile with flattened use areas (manos, 83.3% convex; handstones, 36.1% convex).

One hundred and five whole and partial manos and 41 whole and partial handstones were collected. Igneous rocks were usually chosen for use as handstones or manos. A slight differentiation was observed in rock types. Manos were manufactured from the finer texture basalts and rhyolites; handstone material was more varied and included scoriaceous basalt, rhyolite porphyries and diorite.

A final major active member type is the pestle. We collected only six whole or partial examples. The whole shapes were uniformly rectangular to cylindrical; fragments were somewhat ovoid. A prominent wear facet occurred on both poles of the pestles. Some polish was observed on the tools' faces, perhaps from use. Four examples were manufactured from basaltic rock, and two were made from micaceous schist.

Rubbing Stones

We tentatively categorized two small ovoid stones as rubbing stones. Their smoothed, polished, convex faces suggest use as polishing or finishing tools. Limited experiments found these artifacts to be useful as anvils in paddling pottery vessels into shape. These artifacts are also of basaltic rock.

Ornamental Pieces of Stone

We also recovered two small ornamental stone artifacts. From Test Pit 4, Level 1 at Az.Z:14:21, a piece of red-colored worked stone was collected which E. W. Haury (1976: personal communication) identified as an argillaceous nose plug, similar to those found at Snaketown.

A six-sided quartz crystal was found in Level 1 at Az.Z:14:29. It showed no evidence of having been worked.

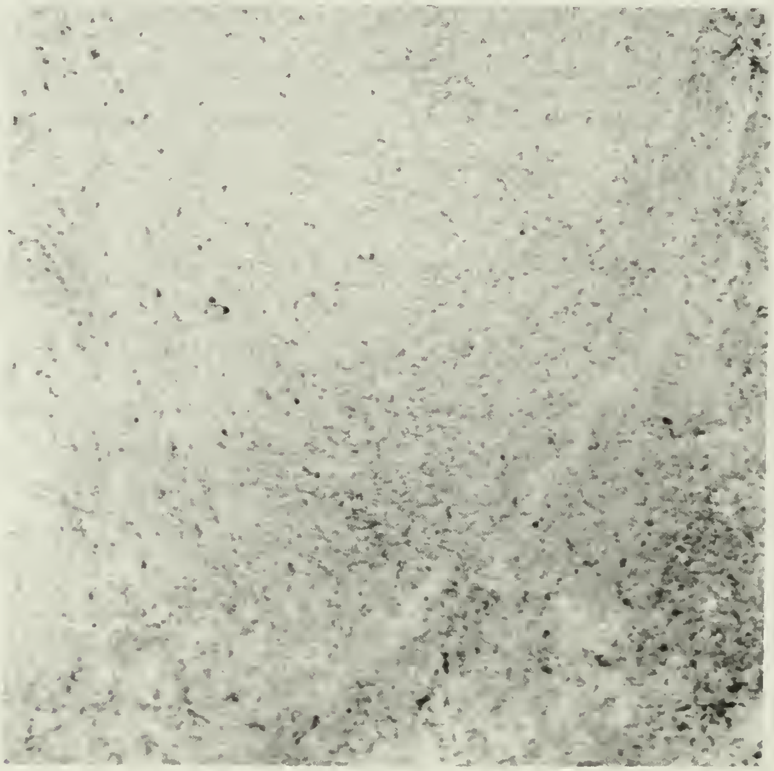


Figure 48. Ochre-stained basin metate, Arizona Z:14:28.

Technology

Analysis indicated raw material for ground stone was selected so that minimal shaping was necessary before use. For millingstones, dressing the exterior to either a roughly ovoid or rectangular shape was the maximum preparation. In contrast, manos are the most carefully worked ground stone. After selection of a dense igneous rock, the flintworker, apparently using a dense "peckingstone" percussor, pecked the exterior to a rounded or ovoid shape. He removed a series of superimposed cores for preliminary shaping of the surface. Subsequently the toolmaker utilized a coarse-textured abrader to smooth the pecked surface. Most manos and perhaps some handstones were apparently abraded to their final shape, though evidence of this process is minimal on the latter. Other ground stone artifacts like mortars and pestles also display some care in preparation. Although seldom definitely geometric in outline, their use areas indicate shaping.

The simple character of the ground stone is partially a result of what rocks were locally available and thus selected for manufacture. Although easily pecked scoriaceous material is often selected for ground stone tools, it was not commonly used by the Quijotoa Valley peoples. Thus, the sophistication apparent in Hohokam metates, manos and mortars is absent in our material.

Specialized tools, like the reamers and abraders, are not only made of micaceous schist as elsewhere, but are also of exotic pitchstone. The pitchstone abraders are unreported at other sites in the region. It may be that this was a local preference. Pitchstone outcrops are uncommon but have been observed in the nearby Mount Ajo Section of Organpipe Cactus National Monument.

The use of micaceous schist to make palettes is a common phenomenon. The customary material for Sedentary and Classic period Hohokam palettes is slate-like Pinal schist (Haury 1976: 286). The palette from Az.Z:14:31 is somewhat more crystalline than the Snaketown versions.

Most of the Quijotoa Valley ground stone material is fragmentary and appears to have been reused for other tools. No material was found incorporated into structures or hearths as occurs in the stone-poor Gila-Salt basin, and few specimens showed evidence of burning.

Sites

Eleven loci produced sufficient ground and pecked stone artifacts to warrant investigating the distribution of material to determine if concentrations represented work areas. Only Az.Z:14:32 and Az.Z:11:5 had concentrations that could suggest specific tasks. In other localities the material had been redeposited by sheet wash, had been randomly abandoned or was recovered from trash dumps. No whole artifact caches were collected, although several were observed outside the right-of-way.

The following loci produced moderate numbers of whole or partial ground and pecked stone tools: Az.Z:11:5, Az.Z:14:21, Az.Z:14:28, Az.Z:14:30, Az.Z:14:32, Az.Z:14:33, Az.Z:14:43, and Son.C:2:22.

Az.Z:11:5, Huihikiwani, produced a collection of 12 pecked and ground stone tools. Although material from here was gathered during all phases of archeological fieldwork, nine of the artifacts were recovered while excavating the pit house. In addition, two reamers were found about 35 meters southwest of the pit house.

Three whole and nine partial tools were collected. Most of these were typed: two round to ovoid handstones, an ovoid mano, two pestle fragments, two reamers, a palette section, two millingstone fragments, a mortar and an anvil. Pit house material was found in floor and fill contexts. Four objects were grouped in the west-central area of the structure, a mortar and broken pestle, a handstone and a palette. A flat pecked stone, possibly a pottery anvil, and a milling surface were found in the northern end of the pithouse. In the southern sector near the wall, another pestle, a metate and a mano were encountered. The tool inventory from the pit house suggests that both food and pigment preparation had occurred within the structure.

Az.Z:14:21, Kokotki, consists of three related loci, A, B and C. Locus A had one ground stone fragment. Locus B produced six specimens. Among them were two millingstone sections, a hammerstone and a pestle which was reused as a hammerstone. Locus C, the most intensively used area at the site, had only a moderate number of ground and pecked stone tools. Eighteen partial tools of various types and two complete manos were collected. Manos and handstones composed 45% of the assemblage. Five fragmentary abraders and reamers were recovered in association with shell ornaments and debitage. A pestle and a mano with a pitted surface were also found. Six of the artifacts, including two of the abraders, came from undisturbed, subsurface contexts.

Az.Z:14:28, Shegoi, Locus B, produced 14 ground stone pieces, one of which was whole. Five millingstone pieces, three mano and six abrader fragments were inventoried. The quantity of abraders and reamers at this locus is noteworthy because the function of the abraders cannot be suggested by analysis or by their association with other artifact categories at this locus. There was a limited amount of worked shell. Likewise stone debitage was not numerous. However, Locus A at Shegoi did produce quantities of shell artifacts.

Az.Z:14:30, Bos Bosque, contributed 29 pieces of ground and pecked stone to our collection. The material was widely scattered across the right-of-way. Three excavated squares placed below a productive surface grid yielded a small concentration of artifacts: a mano and handstone fragment, a mortar section and an abrader. Other tools from the surface at the site were metate fragments, handstones, manos and abraders.

Az.Z:14:31, a small locus greatly dissected by wash activity, lies south of Az.Z:14:30. A test pit was dug here under a small amount of surface material, and a small incised palette of micaceous schist was found. This area and a second concentration of material due east were eventually avoided by the road.

Az.Z:14:32, Gu Vo Waw, had the second largest ground stone component. Ninety ground stone artifacts were collected from primarily surface contexts. Stretching 400 meters along the right-of-way near the Gu Vo Wash, the site had three major areas of tool concentrations. These appear to be related to site activities rather than to redeposition. Only four of the artifacts were whole, so little can be said about ground stone styles during the two time periods represented at this site.

Fifty-nine of the tools were typed, including 15 millingstones, seven handstones, 31 manos, five abraders and a mortar. Several of the above tools had been reused as hammerstones or "pitted" stones.

At the northern periphery of Gu Vo Waw, seven tools were encountered. The terrace along the wash to the south, which was primarily aceramic, had the densest concentrations of ground stone. Three major concentrations were associated with the primarily aceramic loci. A majority of the specimens from these loci were manos or handstones. Millingstones were also present. In contrast, the portion of the site which produced Yuman ceramics had a scattered ground stone assemblage which was markedly different from the aceramic concentrations. Here a variety of ground and pecked stone tools were found: abraders, reamers, manos, millingstones, mortars and pestles. A "pitted stone" was also identified, and this small mortar-like tool appears exclusively at Yuman (Sand Papago) activity areas.

Az.Z:14:33, Gu Vo Hiktani, had three loci representing numerous time periods. Locus A produced material from the Tanque Verde and Papago periods. There ground and pecked stone came from surface collections and 14 excavation units which had been placed on a mounded trash dump. Of the 82 ground stone pieces, 70 were fragmentary. Two units produced considerable amounts of artifacts, including four manos, a handstone, an abrader and nine tool fragments. At this locus, nine millingstones, eight handstones, three manos, a mortar, six abraders and five multiple-use tools were identified.

Locus B at Gu Vo Village was an artifact concentration of 22

artifacts (one whole) on the first terrace south of Gu Vo Wash. It appeared to be a mixed San Dieguito and Amargosan activity area with few ceramics. Ground stone pieces were scattered across the terrace. Millingstones and manos predominated in the collection. Two abrader fragments completed the assemblage.

Locus C at Gu Vo Village was a sherd and lithic scatter lying between Locus A and Locus B. Forty-six artifacts were collected here from within the right-of-way. Material was more abundant in the eastern and central portion of the gridded area. Seven millingstones, three handstones, 16 manos, two abraders, a pestle and several multiple-use tools were identified.

Az.Z:14:43 was a small Sand Papago activity area from which 12 ground stone tools were collected. Material was scattered in the eastern section of the right-of-way. Manos and handstones constituted one-half of the material; two were reused. The other half included a mortar, a pestle, an abrader, a millingstone and two unidentified pieces of stone.

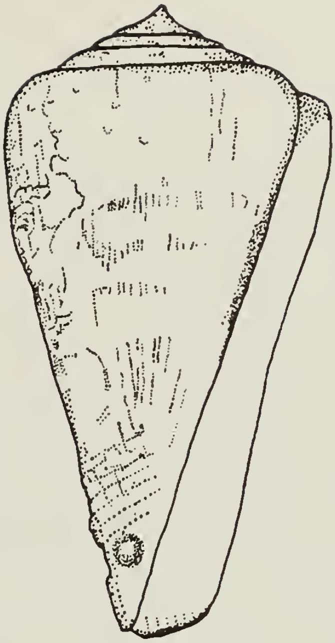
Son.C:2:22, Locus A, consisted of a single feature, a roasting pit and several artifacts. Fire-cracked ground and pecked stone was recovered, and two manos were identified.

Conclusions

The paucity of ground stone artifacts in the project area requires some explanation. As several sites showed only temporary or short-term use, limited ground stone inventories are expectable at these loci. Alternatively, the nature of subsistence activities may have made the development of extensive ground stone tool kits unnecessary. However, food processing tools are minimal in the assemblage, particularly at the apparently semi-permanent ceramic period sites, possibly indicating that food processing activities were infrequent in our limited project area.

The use of ground stone tools like abraders and reamers is well documented in our collections. These tools come primarily from ceramic period sites with extensive shell debitage. It is not unwarranted to suggest that a major use of the ground stone tool was to produce shell ornaments.

Quijotoa Valley ground stone reveals no stylistic trends. Although a major ground stone complex was found at the Amargosa II locus at Az.Z:14:32, it lacks distinctiveness and is difficult to compare with contemporary material from Ventana Cave or the Sierra Pinacate. Likewise, tool shapes from Sells phase sites do not correspond to types described from Jackrabbit Ruin. Therefore, Quijotoa Valley ground stone may be simply an expedient local tradition using available stone for tool production and food processing.



SHELL

By

E. Jane Rosenthal

Survey and excavation within the P.I.R. 1 right-of-way and at Huihikiwani (Az.Z:11:5) recovered 1,533 classifiable pieces of shell. Of these fifteen genera of oceanic and two genera of land mollusks were identified. These are primarily bivalves, though there is a minor component of univalves. The most common genus is Glycymeris, a large clam. The cockle, Laevicardium, is also well represented (Table 16).

Completed and partially completed shell ornaments are numerous. The types are similar to artifacts found at contemporaneous sites within the Papagueria and in both the Gila-Salt and the Tucson Basins. Our shell assemblage suggests a well established system of Glycymeris bracelet manufacture, using the Hohokam technique (Haury 1976: 305-6).

Table 16 SHELL GENERA FROM MAJOR SITES

	Az.Z:11:5	14:22a	14:22b	14:22c	14:28a	14:28b	14:30	14:32	14:33	GuVo 3	Other	Total
Glycymeris	13	12	95	174	57	9	39	7	526	30	27	989
Laevicardium	7	0	18	150	4	0	11	12	126	6	27	361
Cerithidea, Cerithium, Neritina, and Pyrene	0	0	1	9	0	0	0	0	7	0	6	23
Sonorella and Succinea	10	0	0	2	1	0	0	0	1	0	0	14
Pteria and Haliotis	0	0	0	16	1	0	1	0	2	0	0	20
Olivella	3	0	0	22	8	2	6	1	0	0	3	45
Conus	4	0	0	10	0	1	1	0	7	3	0	26
Other	2	0	3	17	3	0	15	0	13	1	1	55
Total	39	12	117	400	74	12	73	20	682	40	64	1,533

Table 17

SHELL PORTIONS

	1	2	3	4	5	6	7	8	10	11	16	Other	Total
Glycymeris	347	367	24	44	0	55	4	9	40	91	0	8	989
Laevicardium	189	88	20	0	0	59	3	0	0	0	0	2	361
Marine Gastropods	4	0	0	0	2	0	0	0	0	15	2	0	23
Land Gastropods	1	0	0	0	0	0	0	0	0	13	0	0	14
Pteria	15	1	4	0	0	0	0	0	0	0	0	0	20
Olivella	7	0	0	0	0	0	0	0	0	38	0	0	45
Conus	12	0	1	0	4	0	0	0	0	5	3	1	26
Pecten	9	1	1	0	0	2	0	0	0	3	0	0	16
Pelecypods	3	2	2	3	0	1	0	0	0	2	0	0	13
Unknown	12	6	0	0	0	1	0	0	0	0	0	0	19
Other Genera	2	0	0	0	0	0	0	0	0	4	1	0	7
Total	601	465	52	47	6	118	7	9	40	171	6	11	1,533

KEY

1 = Valve
2 = Margin
3 = Hinge
4 = Umbo

5 = Spire
6 = Valve/Margin
7 = Valve/Hinge
8 = Umbo/Hinge

10 = Shatter
11 = Whole
16 = Column
Other = Periostracum, Hinge-Margin, Umbo-Margin, Valve-Umbo

Methods

The large quantity of shell was accumulated by total surface collecting along the right-of-way and careful screening of all excavated units. Shell collected during fieldwork was cleaned and labeled in the laboratory. First the number representing each common genera was noted, then the portion of shell involved. Descriptions included the provenience, genus, shell portion, probable artifact type and number of specimens. Categories established by Haury (1976: 305-21) for the Snaketown shell were used in the preliminary descriptions. Final taxonomic affiliation was established by comparison with the invertebrate collection at the University of Arizona, with assistance from the curatorial staff of the Department of Biology and Dr. W. B. Miller.

From the recording sheets, material was coded for the computer using Fortran. The Statistical Package for the Social Sciences (SPSS) provided frequency data on individual sites and an overall cumulative pattern. For sites having more than 30 pieces, a series of cross-tabulations comparing genus, artifact type and portion were produced. As a final step, a cross-tabulation of items from all sites was completed.

Distribution

Table 16 lists the proveniences and genera of shell pieces. A total of 1,533 items were classified. Of this number, 421 were recognizable ornaments. The remaining 1,112 pieces were fragments resulting from ornament manufacture and vessel breakage. Recognizable ornaments were often in preliminary stages of manufacture. Glycymeris was the most common shell genus, with 989 pieces identified; Laevicardium was less abundant (315 items). A major portion of the assemblage consisted of valve fragments, but worked and broken margins, hinges and umbo sections were also present.

MARINE

Aequipecten circularis Sowerby

Aequipecten vogdesi Arnold

Cerithidea montagnei Orbigny

Certithium stercusmuscarum Valenciennes

Conus regularis Sowerby (Lithoconus)

Glycymeris gigantea Reeve

G. maculata Broderip

Haliotis cf. cracherodii Leach or fulgens Philippi

Laevicardium elatum Sowerby

Lyropecten subnodosus Sowerby

Neritina luteofasciata Miller (Theodoxus)

Olivella dama Wood

O. gracilis Broderip and Sowerby

cf. Pinna/Atrina

cf. Pteria sterna Gould

Pyrene strombiformis Lamarck

cf. Tegula Lesson

Turritella cf. gonostoma Valenciennes

Turritella cf. leucostoma Valenciennes

LAND

Sonorella sitiens Pilsbry and Ferris

Succinea californica Fischer and Crosse

Taxonomy

Some shell species were recognizable; for others, even the genus identification is tentative. The taxonomic information presented in Keen (1958) is used to identify the genera among our shell artifacts. All marine shells come from the Gulf of California with the exception of the Haliotis. Many can be collected today on the Sonoran coast, for instance, at Cholla and Adair Bays. Bivalves, such as clams (Glycymeris), cockles (Laevicardium) and scallops (Pecten) are the most commonly worked artifacts, but snails like Olivella, Conus and Turritella also are frequently found in both worked and unworked conditions. There are a few fragments of nacreous shells like Pteria, Pinna and Haliotis.

Aequipecten circularis Sowerby. Scallop.
A common species found from the Gulf of California to Peru. It has dark orange to purple bi-convex valves. It has been found archeologically at Escalante Ruin (Debowski 1974: 81, as Argopecten circularis Sowerby), at Snaketown (Haury 1937: 135, as Pecten circularis) and at Ventana Cave (Haury 1950: 362).

Cerithidea montagnei Orbigny. Snail.
Found in mudflats and, particularly, mangrove swamps from San Ignacio Lagoon, Lower California, to the Gulf of Ecuador. It has bright brown surface ornamentation on white. It clusters upon roots in brackish water. It has been found archeologically at Santa Rosa Wash (Domeier 1974: 335).

Cerithium stercusmuscarum Valenciennes. Snail.
Found on sand flats and estuaries from Lower Califronia to Peru. It may be identified by its color, bluish gray to brown speckled with white. It has a marked spiral row of pointed tubercles below the sutures. It has been identified archeologically at the Fortified Hill Site (Greenleaf 1975b: 265), Los Muertos (Haury 1945: 146) and Snaketown (Haury 1937: 135-6).

Conus regularis Sowerby (Lithoconus). Snail.
Found interidally to 55 fathoms in the Gulf of California south to Panama. Typically it has a low, smooth, slightly concave spire. It has not been identified previously in archeological contexts.

Glycymeris gigantea Reeve. Clam.
Found in shallow to moderately deep water only in the Gulf of California. Single valves are common beach drift. One of the largest species of Glycymeris, it has a white ground color with a reddish brown zigzag pattern and thirty hinge teeth. It has been found archeologically at Punta de Agua (Greenleaf 1975a:98), Escalante (Debowski 1974: 58) and Snaketown (Haury 1976: 307).

Glycymeris maculata Broderip. Clam.
Found in shallow to moderately deep water from the northern Gulf of California to Peru. Its smaller size and spotted brown exterior distinguishes it from gigantea. It has been identified archeologically at the Fortified Hill Site (Greenleaf 1975b: 265), Punta de Agua (Greenleaf 1975a: 98), Escalante (Debowski 1974: 58), Snaketown (Haury 1937: 135-6) and Ventana (Haury 1950: 362).

Haliotus cf. fulgens Phillipi (green) cf. cracherodii Leach (black).
The only Californian coast genus found among the shell. It lives from the intertidal zone to moderately deep water (Morris 1966: 53). It has a nacreous blue-green inner surface. Haliotus has been identified archeologically at Snaketown (Haury 1937: 135-6).

Laevicardium elatum Sowerby. Cockle.
Found in mudflats from the Gulf of California to Panama. Its large, inflated, white valve has only faint traces of ribs. It has been found archeologically at Escalante (Debowski 1974: 58), Jackrabbit Ruin (Scantling 1940: 12), Los Muertos (Haury 1945: 146), Punta de Agua (Greenleaf 1975a: 98), Snaketown (Haury 1937: 135) and in the volcanic debris and more recent layers at Ventana Cave (Haury 1950: 362).

Lyropecten subnodosus Sowerby. Scallop.
Found in deeper waters from the Gulf of California to Ecuador. It is dull purple to white and sometimes orange or magenta and has ten to eleven radial ribs. It has been reported previously only from Snaketown (Haury 1937: 135-6).

Pecten vogdesi Arnold. Scallop.
Found in shallow off-shore locations of the Gulf of California to Peru. It has a distinctive flat to concave left valve and is bright red-brown. It has been found archeologically at Escalante (Debowski 1974:81), Los Muertos (Haury 1945: 146 as Pecten excavatus), Snaketown (Haury 1937: 135), and Ventana Cave (Haury 1950: 362).

Neritina luteofasciata Miller (Theodoxus). Snail.
Found at the margins of mangrove swamps or on mudflats from the Gulf of California to Panama. It is a small, shiny shell pat-

terned with lines and dots and is brown around the aperture. It has been encountered archeologically at the Fortified Hill Site (Greenleaf 1975b: 265) and at Snaketown (Haury 1937: 135-6 as picta).

cf. Olivella dama Wood. Dwarf olive.
Found from the head of the Gulf of California to southern Sonora. It is a stout white shell with faint brown or gray zig-zags and a violet spire, tip and aperture. It has been found archeologically at Escalante (Debowski 1974: 162) and at the Fortified Hill Site (Greenleaf 1975b: 265).

cf. Olivella gracilis Broderip and Sowerby. Snail.
Ranges from Guaymas, Sonora, to Panama. It is a slender white shell with brown patterns in two rings. It has been found archeologically at Punta de Agua (Greenleaf 1975a: 98).

Pyrene strombiformis Lamarck. Snail.
Found from the central Gulf of California to Peru, under rocks in intertidal zones. It has an olive exterior spotted with a white zig-zag pattern. It has possibly been identified archeologically at Punta de Agua (Greenleaf 1975a: 98).

Turritella cf. gonostoma Valenciennes. Snail.
Found from La Paz, Lower California, to Ecuador. This is the largest and heaviest of the Panamaic turritellas. It has light gray to purple brown spots on a white background. It has not been previously identified archeologically.

Turritella cf. leucostoma Valenciennes. Snail.
Found from Lower California to Panama at depths up to 20 fathoms but more common as beach wash. It is a light, buff-colored shell striped with reddish-brown markings. Each whorl is contracted above its suture. It has been identified archeologically at the Fortified Hill Site (Greenleaf 1975b: 265), Snaketown (Haury 1937: 135 as tigrina) and at Ventana (Haury 1950: 362 as tigrina).

Tentatively Identified Shells Include:

Pinna/Atrina perhaps Atrina maura or Atrina tuberculosa Sowerby.
Probably the latter as the Pinnas are found further south in the Gulf of California.

cf. Pteria sterna Gould. Pearl oyster.
Found from southern California through to Peru in shallow off-shore waters. Its shell is thin, brittle, dark brown on the outside, and nacreous white within.

Table 18 SHELL RECOVERED AT PROJECT SITES

Category	Az.Z:11:5	14:22a	14:22b	14:22c	14:28a	14:28b	14:30	14:32	14:33	Misc.	Total
Bracelet	2	1	4	13	3	0	3	0	32	2	60
Rings	0	0	0	16	2	0	3	0	6	0	27
Pendant/Bead	2	0	0	44	6	2	14	1	48	4	121
Tinkler	2	0	0	6	0	1	2	0	5	1	17
Whole Valve	12	0	4	13	20	3	4	0	15	13	84
Fragments	19	11	97	296	36	6	40	19	510	78	1,112
Ground Valve	2	0	12	12	7	0	3	0	66	6	109
Other	0	0	0	0	0	0	3	0	0	0	3
Totals	39	12	117	400	74	12	73	20	682	104	1,533

Land Gastropods:

cf. Tegula Lesson. Snail.
Fresh water mollusks were identified by Dr. W. B. Miller of the Department of Biology, University of Arizona. Two species were present.

Sonorella sitiens Pilsbry and Ferriss. Snail.
There was only one specimen of this land snail, which lives in deep rock slides and very dry habitats. It comes from an excavated unit at Huihikiwani (Az.Z:11:5).

Succinea california Fischer and Crosse. Snail.
The Succinea is another land snail, but its habitat is very wet locales. There were sixteen specimens from several different sites.

Ornaments

Types of ornaments were identified after comparisons with shell artifact descriptions from other regional sites. Based on the Snaketown assemblage, eight categories were recognized and a ninth was inferred. These are described below.

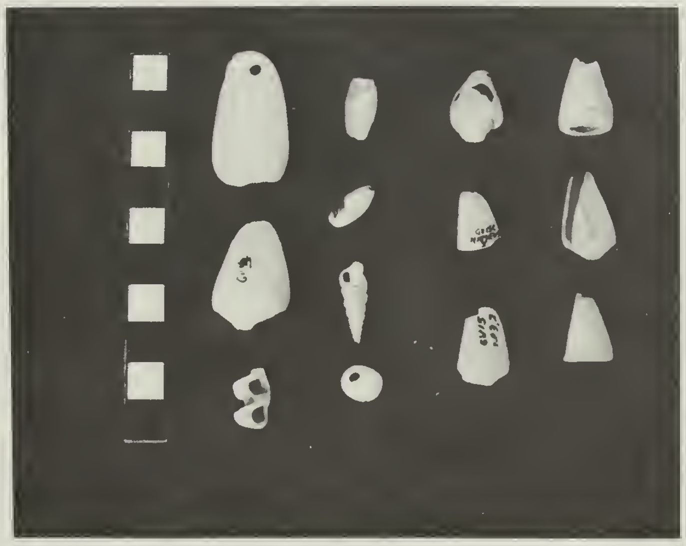
Beads (Fig. 49a): Whole shells with the spires removed by grinding, or with the side wall having a small hole punched or ground into it. Spire-ground types are made from Olivella and Pyrene shells. Perforated or wall-ground types are made from Cerithium, Pyrene, Neritina and Cerithidea shells. Both beach-washed (whitened and eroded) and fresh valves are used.

Pendants (Fig. 49b): Whole shells perforated for suspension. Drilling and, more commonly, grinding of the umbo portion of the valve pierced the shell. Pendants are manufactured on Aequipecten, Pecten, Haliotis, Pteria and Pinna/Atrina shells.

Pendant/Beads: Some small, whole shells are perforated or abraded at the umbo. They could have been strung as beads or just suspended singly. These ornaments are made from immature Glycymeris.

Rings (Fig. 50): Some small valves are perforated by flaking and grinding, and the remaining hinge and margin polished. All rings are manufactured from Glycymeris.

a. Pendants and cut shell.



b. Conus tinklers and beads.

Figure 49. Shell ornaments.

Bracelets (Fig. 50): The central portion of large Glycymeris valves are chipped and ground to perforate the shell. The hinge and margin are polished. Occasionally, the umbo is perforated by abrasion. There are no carved specimens.

Tinklers (Fig. 49a): If the spire of Conus shell has been ground away and a hole made in the dorsum (the back of the gastropod shell, opposite the aperture), it is called a tinkler. Some examples show wear from the rubbing of a suspension thread. There are no whole specimens; breakage appears to have occurred along the longitudinal slit in the tinkler valve. All are manufactured from Conus regularis.

Awl or needle (Fig. 49b): A single Glycymeris margin fragment, ground to a curved, pointed form was recovered. Because of its shape, it is categorized as an awl or needle, although it is broken, unperforated, and its function is unknown.

Cut ornaments (Fig. 49b): Some portions of nacreous valves are cut into a geometric design. Since they are incomplete, it is not known if they are pendants or appliques. They are made from Haliotis and Pteria.

Containers: Numerous broken Laevicardium shell pieces were recovered. Some may be pendants or cut shell, or more likely fragments of whole valves used as scoops, vessels, or paint containers similar to those described by Haury (1950: 364) in the Ventana Cave Report.

Figure 50. Shell bracelets and rings.

Only one category of ornaments displayed stylistic variation, the Glycymeris bracelet. Haury (1976: 313) suggested that three chronologically distinct bracelet variants could be identified at Snaketown. Type 1 was a thin band 2.5-4.0 mm thick; Type 2, a medium band 4.0-6.0 mm thick; and Type 3, a thick band 6.0-10.0 mm thick. Their thickness tended to increase from Colonial to Classic Hohokam times.

Forty-five bracelets from the Quijotoa Valley Project were measured and compared to Haury's ranges for each type. Our distribution follows: Type 1 - 3(6.6%), type 2 - 13(28.8%) and type 3 - 29(64.4%). To see if the types were also chronologically distinct, two sites of differing time period were compared: Az.Z:14:22, a late Sedentary period site, and Az.Z:14:33, a Classic period site. The differences between the means are insignificant: .6456 and .6565, respectively. Furthermore, there appears to have been no significant difference in mean thickness between the sites. Therefore, Haury's three types are not supported by our data.

Technology

Manufacturing techniques used to produce the Papagueria shell ornaments included grinding, chipping, drilling and cutting. The major method of working the shell is by abrasion. Chipping is an intermediate technique for working ornament blanks. Cutting is reserved for the production of geometric shapes from nacreous shell, while drilling is occasionally used to perforate pendants.

Recovery of whole valves, valve fragments and shell debitage from the Quijotoa Valley shows that ornaments were manufactured at the sites (Fig. 51b). Broken shells have chipped margins, ground facets and attempted perforations, indicating breakage during processing. Forty-five whole, unworked, and 96 ground or flaked valves of Glycymeris were collected. In this group of Glycymeris specimens, including debitage, 14.3% were in the initial stages of ornament manufacture. Less than one-third were finished bracelets.

Judging from the artifacts, bead and pendant manufacture was fairly simple. The only treatment of the valve was perforation by grinding away the spire, valve wall or umbo, depending on the genus. In a few cases, small holes were punched through the lip of gastropods. Tinklers required additional work to complete. Abrading removed the spire to its last suture. Then the Conus was perforated by drilling a hole from the exterior to the interior. A groove was apparently made longitudinally from two-thirds of the way up the shell to near the final suture, either before or after the spire was removed. Geometrics were cut from nacreous shell. Their edges slant in one direction and are unrounded to form elongated ovoids or crenulated-edged pendants.

Rings and bracelets have similar techniques of manufacture (Fig. 51a). As Haury (1976: 306) previously described them for Snaketown, grinding initiated valve perforation and chipping subsequently enlarged the hole. Reaming of the circle with a cylindrical tool of micaeous schist finished ring and bracelet manufacture. At times, the umbo was also perforated by abrading, perhaps for suspension.

In contrast to the technique of bracelet making employed by the Hohokam, a second technique from Sonora was found at La Playa (Johnson 1960: 179). There a file was used to make an exterior groove which encircled the central portion of the valve. When the groove was nearly through, the end of a reamer was used to punch the central disk clear, leaving a rough circle of shell which was then abraded and smoothed to finish the bracelet.

In the Quijotoa Valley material, only two valve disks were identified. They were partially ground, matching the second process of bracelet manufacture as described by Johnson for La Playa. In this method the convex side of the valve was rubbed across the abrader until the center was removed. All other shell techniques observed among the Quijotoa Valley sample are identical with the Hohokam shell manufacture system. Several reamers of micaceous schist and of pitchstone were recovered during our fieldwork. These finds further confirm the presence of the Hohokam technique and match specimens from Snaketown identically (Haury 1976: 284).

a. Whole shell, Arizona Z:14:28;
one shell, Arizona Z:14:33.

b. Shell manufacturing sequence,
Arizona Z:14:33.

Figure 51. Shell manufacture.

Conclusion

Considering that excavations occurred only at the major shell-producing loci, the quantity and variety of material collected is impressive (Fig. 52). All major shell loci (those with 30 or more specimens) are associated with small settlements of the late Sedentary to early Classic periods (predominately Sells Phase) (Table 18). These artifacts represent the Hohokam techniques of shell ornament manufacture, although they are less sophisticated than the Riverine Hohokam shell industry and lack the sculpturing, zoomorphic design and mosaic characteristics of Gila-Salt Basin material.

Fontana (1965: 95) noted in his 1965 survey of the Cabeza Prieta Game Range that the Hohokam shell trails crossed the north-central Papagueria. Lost City in the Growler Valley and Charley Bell Well in the Growler Mountains were its connecting links to the coast. Hayden (1970: 78) elaborated on these Hohokam shell expeditions, describing several routes and

Figure 52. Worked shell from Arizona Z:14:28

placing a major trail through the Sonoita and Ajo Valleys, just west of our project area. The data from the Quijotoa Valley sites suggests that another prehistoric shell route can be placed further east than previously indicated. The quantity of unworked and partially worked shell indicates that a Tanque Verde phase trail or trade route traveled north through the Quijotoa Valley at least to Huihikiwani (Az.Z:11:5) and presumably continued on, either to the Gila River sites or to the Santa Cruz River. Alternatively, long-term Papagueria shell exchange may have focused on villages in the Quijotoa Valley.

BONE ARTIFACTS

By
Richard S. White

A limited number of bone tools were recovered during fieldwork activities (Fig. 53). The nine bone fragments showed evidence of use, although not all appeared to be deliberately finished. All were from large mammals, probably deer.

For descriptive purposes, the tools have been placed in three categories:

Type A (Fig. 53a-c): Bone awls made from a deer metapodial, either proximal or distal. The natural articular end of the bone forms the end opposite the tool point. Three examples were recovered, all from the pit house at Az.Z:11:5. Two examples retained the distal condyle of the metapodial as their handle; the other had a handle formed by the proximal end. In both cases, the metapodial had been split lengthwise in making the awl.

Type B (Fig. 53d-g): Bone awls made from splinters of large mammal bone. No effort seems to have been made to smooth or otherwise finish the non-functional end of the tool. Six examples are in the collection, four from Az.Z:14:33, one from Az.Z:14:21 and a final one from the pit house at Az.Z:11:5.

Type C (Fig. 53h, i): Small fragments of worked bone, most likely from broken awls. Two examples were recovered, one from Az.Z:14:21 and one from Az.Z:14:30.

Figure 53. Bone artifacts. Type A - a, b, c; Type B - d, e, f, g; Type C - h, i.

Discussion

The condition of these tools and data on their lengths and widths is summarized in Table 19. At present, there is a paucity of information on bone awls, except for Haury's discussion (1950: 375-9) on Ventana Cave. At that site, 111 bone awls were recovered. Our types A and B were both represented in the midden material at Ventana Cave. No temporal or cultural affiliations, however, could be attributed to these artifacts.

It may be presumed that all our awl types are common to the late Sedentary and Classic periods because of their archeological context. It is not possible, at present, to suggest that they belong exclusively within that time frame.

Table 19 BONE TOOL ATTRIBUTES

Specimen No.	Site	Length	Max. Width	Burned	Type
HPH-1-8-3	Az.Z:11:5	106.5	23.5	no	A+
HPH-1-11-2	Az.Z:11:5	94.3	19.8	no	A
HPH-1-4-1	Az.Z:11:5	80.9	9.6	no	A
32a-71-79-4	Az.Z:14:33	59.1	10.1	no	B
32a-70-75-3	Az.Z:14:33	61.8*	11.8	yes	B
32a-72-79-5	Az.Z:14:33	56.1	7.7	no	B
32a-70-77-5	Az.Z:14:33	65.7	11.9	yes	B
15c-191-123-2	Az.Z:14:21	39.6*	15.4	yes	B
15c-189-121-6	Az.Z:14:21	20.4*	7.6	yes	C
28-131-107-1	Az.Z:14:30	19.1*	10.3	yes	C
HPH-1-8-3	Az.Z:11:5	29.5*	7.5	no	C

* Measurement of broken fragment.

\+ Refer to type descriptions in the text.

DISCUSSION

By

E. Jane Rosenthal, Douglas R. Brown,
John B. Clonts and Marc B. Severson

The Quijotoa Valley Project recovered data from a previously unresearched portion of the Papago Indian Reservation. The 1973 survey recorded cultural material in 43 separate locations within a 100-foot right-of-way. A few loci were combined, several were determined insignificant and one was avoided; only 13 were investigated prior to road construction. Artifacts discussed in this report, therefore, present a limited perspective on the known resource variety and complexity in the western Quijotoa Valley.

Our research goals were simple. We wanted to elaborate the regional chronology and to learn about the uses of this arid environment. Although much material was collected, our goals were not fully realized, and the picture of aboriginal lifestyles in the valley remains incomplete. Because our conclusions are biased by the site area, our speculative summary will no doubt be rewritten in the future.

Since our sites were not all contemporaneous, we first had to identify their chronological affiliations. As our cultural resources were superficial, fragile and minimally preserved, problems of preservation and context in the Papagueria compounded the difficulty of developing the region's culture history. In presenting our project summary, we recognize our problems, as well as detail our conclusions.

REGIONAL CULTURE HISTORY

In the Quijotoa Valley Project sites, four cultural periods are clearly identifiable; two additional periods are indicated. Only two of the identified periods, however, are stratigraphically secure and radiometrically dated. The other periods are relatively dated by comparison with material from Ventana Cave and the California Desert.

Although our evidence clearly indicates widespread use of valley resources in preceramic periods, we cannot affix calendrical dates to these sites. Their surface nature and subsequent reoccupation complicates the problem.

Two of these loci, one along Gu Vo Wash at Az.Z:14:33 and a second at Son.C:2:15, appear contemporaneous with the early Ventana complex material described by Haury (1950: 178-89). This suggests that by the late Pleistocene, the Quijotoa Valley was probably being used for both hunting and gathering. Our simple tool-kit is dominated by large unifaces and bifaces of basalt, accompanied by smaller utilized flakes and notched tools, often produced on rhyolite. We suspect that a series of large, broken, weathered bifaces from these sites are contemporaneous with the above tools. A San Dieguito (late paleo-Indian or early Archaic) affiliation is possible, but since less than 200 tools of this early occupation were found at Project sites, our identification is tentative.

Other material confirms the use of the Gu Vo Hills section of the valley by Amargosan people. Stone features outside the right-of-way, extensive areas of tools and debitage and, most definitively, a series of Pinto, Amargosa and Cochise points clearly indicate this presence. Several specific locales document Amargosan use. The earliest are the Amargosa I (Pinto) materials from Az.Z:14:28 and Az.Z:14:33. San Pedro type points were also found, both the corner-notched stemmed variety (Type 3) at Az.Z: 14:32 and the serrate (Type 4) at Az.Z:14:33. Finally, small, thin, corner-notched points (Types 11 and 12), just antedating the early Ceramic period (Haury: personal communication), conclude our examples of Amargosa II occupation.

There is a hiatus in our sample between late Amargosa II times and the Ceramic period. Six sites have prehistoric ceramic components and five manifest the Sonoran Brownware Tradition. It is noteworthy that although Colonial period Vamori phase material is known to exist east of the project area, our earliest ceramics at Az.Z:14:21 represent the late Sedentary transition from Topawa to Sells phase. Arizona Z:11:5, Az.Z:

14:28, Az.Z:14:30 and Az.Z:14:33 all date to the early Sells phase, probably prior to A.D. 1300. In contrast, one locus at Az.Z:14:32 has Yuma II ceramics.

The final period represented by Quijotoa Valley ceramics is Historic. It should be emphasized that these artifacts are technologically Papago and Yuman but have no associated European material. Several small loci have Yuma III (Son.C:2:15) or mixed Yuma III and Papago artifacts (Son.C: 2:25).

This, briefly, is the chronologic picture. Our earlier material can only be relatively dated; Sells phase and historic materials may be tentatively fixed by radiocarbon dates (Appendix II). With radiometric procedures several interpretive problems should be recognized. First, our radiometric dates for the prehistoric Sells phase material do not comply with the currently accepted dating of that phase. Prior to receiving our dates, we assigned material to the phase by the presence of Sells Plain, Tanque Verde Red-on-brown and limited amounts of Sells Red pottery. Dr. E. W. Haury reviewed our identification and confirmed that our material was Classic period, developed Tanque Verde and Sells ceramics. Meanwhile, charcoal from hearths was sent to two separate laboratories for dating. Despite cautionary measures, the calibration of dates with tree ring sequences and a correction for contamination by modern carbon, the radiocarbon dates are one to two centuries earlier than anticipated.

Therefore, two interpretations of the late Prehistoric period in the Quijotoa Valley must be presented. First, possible contamination of the charcoal or the advanced age of the trees burned may have invalidated the carbon dates. If this is accepted, then the time range of our sites is from the expected late twelfth to the fourteenth century. On the other hand, if our radiocarbon dates are correct, then we must reinterpret the Sells phase. This would mean that the Topawa phase spans the ninth to late tenth centuries and that the Sells phase begins in the early eleventh century.

It is perhaps wisest at this time to suggest a compromise position. Even if we regard our dates as somewhat too early due to sampling problems,

we must reiterate that two separate sites, Az.Z:11:5 and Az.Z:14:30, were independently dated, so their dates should not be dismissed. Therefore, it seems that in this case an inception of Sells is indicated before A.D. 1100.

The complete absence of polychromes and the insignificant presence of Classic redwares support this new date for Sells phase. Our design elements are not as complex as late Classic period styles in the Tucson Basin. Classic period ground stone styles are also absent. Although alternate interpretations of the artifacts are possible, we prefer to date our predominate occupation to the time span A.D. 1050 to 1300.

After clarifying the temporal problems, we can suggest a cultural tradition represented by the Quijotoa Valley sites. For the Preceramic period it is appropriate to describe tool complexes, rather than cultures, as other artifacts are absent. Because early sites are surficial, our recognizably older, typical tools and points were used to suggest chronologic periods. Our preceramic complexes are quite similar to other widespread western desert traditions, as described by Haury and Hayden who recognize the varying influences on a basic, simple tool kit. Our Amargosan materials, with their Amargosa, San Pedro and Pinto points, demonstrate the difficulty of discussing a "culture" during the extended preceramic time span. We can only identify the continuity of tool types and manufacture.

In the Ceramic period, two possible cultural traditions could be responsible for the site assemblages. These are the "Desert Hohokam" (Haury 1950: 14) and the "Sonoran Brownware Tradition" (Ezell 1955). We categorized sites only as Sonoran Brownware Tradition for the following reasons. First, recent discussions have confused the original appellation of both Desert and Riverine Hohokam. According to Haury the Desert Hohokam were a geographically-based division of the Hohokam, who practiced a predominantly food-gathering economy in the Papagueria. In contrast we have described cultural groups in terms of their ceramic and stone working traditions, rather than by their economies, because we have only inferential information about subsistence. Second, the Riverine/Desert dichotomy,

and its accompanying cultural traits, overlooks the presence of Hohokam (buffware) traditions at non-riverine sites in the Santa Rosa Wash area (Raab 1975). Such wash-agricultural villages more fully conform to an expectation of a "Hohokam" desert adaptation in the Papagueria.

The Quijotoa Valley Project sites differ from both the Gila-Salt sites and the villages along the Santa Rosa Wash. Ceramics and stone tools are distinctively made, and houses, when present, are unlike Classic period structures. Ezell has defined this situation as the Sonoran Brownware Tradition. To expand on his presentation (with due credit to DiPeso (1956) and Hayden (1970), who have presented similar notions), it appears that the local cultural tradition present in the Papagueria is influenced by the Trincheras people to the south, the Hohokam to the north and the Yuman to the west. These influences may be observed in ceramic and shell styles at our sites. Strongest contacts appear to be with the Yuman people, documented by their intrusive ceramics.

"Sonoran Brownware Tradition" is a rural lifestyle reflected in roughly shaped ground stone, in simple flake tools and, most importantly, in igneous clay ceramics. There are no canals or reservoirs, deliberate cremation, elaboration of ornaments, votives or the like. This rural lifestyle was first identified at Valshni Village (where Trincheras and Hohokam tradewares are found) and existed contemporaneously with Hohokam sites in the Papagueria, such as Gu Achi, Pisinimo and Lost City. The Papaguerian Sonoran Brownware Tradition does not appear to evolve from Red-on-buff colonizers (Gila-Salt Hohokam) through a gradual shift in tool mediums, but appears to be distinct from its inception onwards. This perspective unites in one tradition archeological cultures, in the Tucson basin as well as in southern and western portions of the modern Papago reservation, which share similar technologies.

Protohistoric and post-Spanish traditions recognized at project sites are Papago. Although Fontana and others (1962) have listed ways to identify Papago material culture, these are not consistently present among our artifacts. Our Papago Plain and Red are mixed with our Yuman ceramics. A lack of clear historic Papago ceramic attributes could date their

production earlier to the 17th and 18th centuries. Alternatively, the strong Yuman component may mean that Sand Papago people historically utilized the Quijotoa Valley. For this period we found only sherd and lithic scatters; thus, it appears that the southern Quijotoa Valley was being used for occasional, temporary activities by the Papago and Sand Papago.

A prehistoric to historic continuum can be inferred from our data, tentatively confirmed by a prehistoric Papago presence at Az.Z:14:33. Two lines of evidence point to at least a 15th or 16th century Papago occupation. First, at Az.Z:14:32, we identified a small activity area with Yuman and (a few) Sells Plain sherds which may be interpreted as prehistoric Sand Papago. Second, at Az.Z:14:33, a Papago component lies on top of Sells phase material without any apparent break in the deposition. Future research will perhaps confirm prehistoric Papago presence there.

ABORIGINAL LAND USE IN THE QUIJOTOA VALLEY

The Quijotoa Valley Project afforded an opportunity to study the uses of wash, plain and lower bajada communities. Thus the second objective of Papago Project research was to learn how aboriginal peoples utilized Quijotoa Valley resources. Investigating this problem required the analysis of three sets of data. First, questions about the present and past environmental context and about factors affecting site selection were asked. Second, the tool inventory was analyzed to identify manufacturing and processing activities. Finally, the whole artifact sample was examined for pollen, floral and faunal information.

Although throughout the Holocene the Quijotoa Valley has not been a stable environment, the present regional communities are similar to those established sometime after 8000 B.P. (Van Devender 1976). In looking at how man used the desert wash, plain and foothill associations, the topography is as important as the biota. The Quijotoa Valley sites clearly demonstrate this. Most sites that evidenced repeated visits share two common physical attributes: (1) proximity to rock outcrops within the

alluvial basin and (2) presence of multiple, parallel feeding washes draining the outcrops and eventually emptying into major washes. Only the parallel sites of Az.Z:14:32 and Az.Z:14:33 were actually placed along a major drainage. Site context suggests that the spreading flood of water, not just its presence, was important.

The animal and vegetal community of the desert wash was the primary food resource in the Project area. The gentle slope, spreading drainage and fine soils of these locales are ideal for floodwater farming, a secondary food source. Historically this agricultural technique has been reported for Papago "ak-chin" farms, although larger wash systems were apparently preferred when water storage for cattle was necessary. Game is attracted to wash areas for water and for the cover provided by the larger trees and shrubs. Trees also provided tools, firewood and construction materials. Nearby rock outcrops occasionally have catchment pools and support stands of columnar cactus. Associated pecked bedrock mortars for processing cactus seeds and mesquite pods were discovered within the outcrops. Thus, food procurement and these other activities could have occurred at spreading washes.

The biotic and abiotic context of the Quijotoa Valley site locations suggests several site functions. During San Dieguito times, before the establishment of the modern Sonoran desert communities, large herbivores roamed the steppe-like environment (Haury 1950: 145). This grassy community was perhaps complemented by an oak parkland in the adjacent Ajo Mountains (Van Devender 1976). The Gu Vo Wash site areas, near both grass and woodland, were a prime location for hunting and foraging. After the altithermal, desert washes may have become one of the few reliable areas for killing game and collecting plant foods. Prior to the introduction of agriculture, especially in preceramic periods when water storage was a problem, they had to be primary resource areas. Our site context thus indicates a continued use of minor washes throughout the prehistoric and historic periods.

Site location and environmental context can only suggest resources available for use. Artifactual material must be analyzed and pollen

spectrums considered in order to identify specific tasks performed in the valley. Our tools and debitage do not express distinct functions or activities in their design. However, the lack of certain flake types does suggest that quarrying and initial tool preparation were minimal, while debitage from tool finishing and resharpening was abundant. The chipped tools clearly show that some hunting was occurring in all time periods, and with this activity one would suspect butchering. Faunal remains, however, do not have butchering marks (Appendix I).

The tools probably represent plant extracting and processing. Ground stone tools were used for mashing and grinding plant seeds, pods and fibrous parts. Tool stains indicate pigment preparation. The worked stone tabular pieces could have been knives or, if hafted, foot-plows or hoes.

Indicating activities by interpreting tool functions is just as difficult as identifying sites functions from their environments. Ethnographic accounts of Papago tools note that food was procured by using wooden sticks, tongs and the like. Analogous items did not appear in our sample. Instead, we probably have the stone tools used to manufacture such items. A conservative interpretation of artifact inventories suggests that hunting, limited tool manufacturing, food processing and shell working may be documented as site activities. Other possible tasks include field cultivation, food procurement and structure construction, but these cannot be confirmed from the tool kits. Remains of hearths, roasting pits and living areas also indicate some household tasks and food preparation occurred. Again a dirth of associated artifacts, particularly ethnobiologic remains, restricts actual activity documentation.

A final source of information on site activities is the faunal and pollen data recovered. As reported by White (Appendix I) and Woolfenden (Appendix III), these data support our assumption that several sites were small agricultural villages with localized hunting. Cultivation is indicated at Az.Z:14:33 and Az.Z:14:21, especially at the former, where a single grain of maize pollen was recovered.

Despite our limited information, we can speculate on Quijotoa Valley aboriginal lifestyle. The San Dieguito and Amargosa remains point to a hunting and gathering subsistence base, using major wash resources. Historic material is often associated with deflated hearths and roasting pits, further evidence for temporary use of local resources. The Topawa and Sells phase sites, however, are dramatically different from these earlier and later loci. Generalizing from the artifactual data, it appears the prehistoric ceramic period saw settlement expansion to ephemeral wash situations where small semi-permanent villages of perhaps an extended family were founded. At these sites seasonal farming, limited hunting and extensive gathering were practiced. In ceramic times, we feel secure in suggesting that site locations point to horticultural activities, with only limited hunting. We cannot say how complete the reliance on cultigens was nor what plants were supplementing the diet. Unfortunately we did not recover this type of data.

To interpret sites with minimal structural remains as semi-permanent villages may seem excessive, but other alternatives appear less likely. Living surfaces and pithouses encountered at Az.Z:11:5 and Az.Z:14:22 certainly indicate prehistoric settled village life. Second, trash mounding was found at one site, Az.Z:14:33, and refuse was widespread elsewhere. Furthermore, we sampled only limited portions of extensively greater material. Even so, our artifact inventories are too varied for just temporary recurring camp sites. Although the styles of items are simple, their variety suggests that these sites are more similar to Valshni Village and Jackrabbit Ruin than to the Hecla camps.

ADDITIONAL RESEARCH PROBLEMS

This discussion has highlighted information which contributes to the understanding of culture history and land use in the Papagueria, our primary research goals. Other issues can be addressed with the Quijotoa Valley data. Recognition of the Sells phase site density and of the local shell exchange are major products of our analysis.

As early as 1929, Gladwin and Gladwin (1929b:81, 119) had detected abundant "Classic" period sites in the Quijotoa Valley, but also noted that they were dissimilar to Casa Grande. Although our Sells phase material is probably not contemporaneous with Casa Grande, nevertheless, the Gladwins' observation has been reinforced by project fieldwork. There is extensive Sells phase occupation in the Quijotoa Valley.

In extending Sells Phase inception to the twelfth century, we are cognizant of the possibility that Tanque Verde Red-on-brown stylistic trends may have begun earlier in our area than elsewhere. Nevertheless, this extension of the Sells phase alone cannot account for the multiplicity of Sells sites. Several explanations for the phenomenon, which should be investigated by future researchers, are:

1. Population increased after the inception of sedentary life and the development of an agrarian subsistence base.
2. Immigration of Piman groups into the area caused the increase in site density (Gladwin and Gladwin 1929b: 129).
3. A settlement change occurred from concentrated villages to dispersed rancherias due to environmental alterations (Grebinger 1971a).

Although our data does not strongly support any of the three suggestions, it does lend credence to the postulated shift in settlement location. First, only one site, Az.Z:14:21, antedates the Classic period, and there is a long post-Amargosa II hiatus in our data. Immigration or more sedentary lifestyle could be inferred, despite our sampling problem. Early sites have been documented in the Baboquivari Valley (Valshni Village) and the Santa Rosa Wash. Later sites appear along more ephemeral washes. Further, smaller campsites also date to the Sells phase (Goodyear 1975: 252). These are indicative of differential use of certain communities or perhaps an expansion of the subsistence base. Even if settlement change cannot be documented, use of new locations can. This leads to the hypothesis that if site frequency increases in the Sells phase, then subsistence practices have altered to include increased floodwater farming associated with gathering activities.

The second problem which arose during analysis was explaining why extensive shell manufacture occurred in this remote locale. Proximity to coastal resources is an obvious reason for the presence of marine shell but does not explain why shell artifacts were made in the Project area, instead of either on the coast or in the Gila-Salt or Tucson Basins. To complicate matters, the Quijotoa Valley manufacturing techniques are identical to those of the Riverine Hohokam. However, during the Classic period, Hohokam shell usage decreased, and shell ornaments were scarce at Desert Hohokam sites (Haury 1950: 319, 547). Hayden (1972: 74), discussing the Hohokam shell expeditions, noted that their routes apparently avoided the north central Papagueria during Sedentary times. It is possible that the shell trading parties began to enter the Quijotoa Valley in the Classic period.

This still does not explain the various stages of shell manufacture and the few finished ornaments which were abundant only at our late Sedentary and our Classic period sites. These were found in refuse contexts or unworked in caches rather than in association with burials. It is also noteworthy that intrusive trade items which could have been exchanged for shell ornaments (like carved stone, turquoise and ceramics) were absent.

We are left with the impression that the shell assemblages documented at Project sites represent local exchange. Perhaps perishable foodstuffs were being traded for shell ornaments. The limited amounts of finished and broken jewelry would negate an assumption of local (on site) use of the items. Clearly, understanding of shell working and trading has been increased by our fieldwork, but determination of the destination of this product will be the job of researchers in other areas.

CONCLUSIONS

By

E. Jane Rosenthal

The purpose of the Quijotoa Valley research was to record and preserve the archeological data within the right-of-way of Papago Indian Reservation Highways 1 and 34 and to begin a reconstruction of the culture history and human adaptive measures of this region of the Sonoran Desert. Problems of a biased sample and of the surface context of many resources limited success in achieving project goals.

As little was known about the Valley, our priority was to develop an idea of regional cultural traditions. Often the concepts resulting from our analysis could not proceed beyond elementary description because comparable data from nearby was unavailable. Attention to the artifacts and their contexts raised questions about current interpretations of regional prehistory. In summarizing information it became necessary to introduce alternative ways of explaining the archeological record. This approach was taken to encourage future researchers to develop a series of "multiple working hypotheses" (Chamberlain 1973) instead of accepting prevailing ideas.

Our general conclusions are that the Quijotoa Valley has been the focus of discontinuous occupation since paleo-Indian times. The region was primarily used during the Sells phase which now appears to date from A.D. 1100 to 1300. Our information suggests that early activities of Amargosan times focused on the Gu Vo Wash system. In ceramic times more ephemeral washes became principal settlement areas.

Division of the cultural sequence into chronologic periods is difficult. What is clear is that over time a local cultural tradition evolved, climaxing in the regional Sells phase material and the Yuman-influenced historic Papago artifacts. Two types of subsistence activities are expressed in the artifacts. The Archaic and Historic material represent temporary camping, hunting and food processing locales. In contrast, the

Sells phase sites are apparently small horticultural settlements involved in shell exchange.

In the final analysis, the Quijotoa Valley Project has raised more questions than it hoped to answer, but the quantity and quality of information recovered encourage further exploration into cultural traditions and land uses in the north central Papagueria.

APPENDIX I

ARCHEOLOGICAL FAUNAS FROM THE QUIJOTOA VALLEY, ARIZONA

By

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ABSTRACT

Archeological excavations at seven sites in the Quijotoa Valley, southwestern Arizona, produced 2,114 fragments of bone, 538 (25.4%) of which were identifiable to at least the ordinal level. Rabbits of three types (*Lepus alleni*, *Lepus californicus* and *Sylvilagus* sp.) dominate the assemblage (58.4%) of identifiable remains, while two species of turtle (*Kinosternon sp*. and *Gopherus agassizi*) account for an additional 20%. Only rabbit and turtle bone showed any appreciable incidence of charring or calcining, supporting the inference that they were the primary animal protein sources. The near absence of large mammal remains (deer, mountain sheep or antelope) is notable. It is hypothesized from this that the sites excavated were summer field villages occupied from July through September and that exploitation of those larger mammals would have taken place from well villages during the remainder of the year. Ethnographic analogy and data from the faunal analysis are used to reconstruct the butchering and cooking procedures.

ACKNOWLEDGEMENTS

I would like to acknowledge the assistance rendered by the following people during the course of this study: Stanley J. Olsen, Department of Anthropology, University of Arizona, for his critical reading of parts of the draft version of this paper and for access to collections under his care; Amadeo M. Rea, Assistant Curator of Birds, Department of Evolutionary Biology and Ecology, University of Arizona, for identifying the bird bones and for discussing various aspects of faunal analysis with me; to Thomas R. Van Devender, Laboratory of Palaeobiology, University of Arizona, for assistance in identifying the amphibian and reptile remains; to Philip Roth, Department of Evolutionary Biology and Ecology, University of Arizona, for access to the mammal collection under his care. Paul Johnson, Pima College, acquainted me with several sources of data on rabbits and provided data on faunal collections currently undergoing analysis which were important in developing my understanding of human exploitation of animal resources in the Sonoran Desert.

INTRODUCTION

During archeological excavations conducted by the Papago Indian Roads Project at seven ceramic sites in the Quijotoa Valley on the Papago Indian Reservation, screening operations recovered a total of 2,114 fragmented animal bones. One quarter of these were identified at least to the ordinal level. Rabbits and turtles were the two commonest remains, and the absence of large mammals was notable.

Procedure

The procedure in the faunal analysis was as follows. The bone was submitted in lots by provenience, each bag marked with the site, excavation unit and level. As each lot was examined, identifiable bone received a catalog number, and unidentifiable bone was counted, recorded and returned to its bag. As each bone was identified to the lowest possible taxon, the identification was recorded and a note made if the bone were charred, calcined or worked.

Methods for comparing faunas depend on (1) their nature and condition and (2) the questions to be asked about them. Ideally the archeologist and faunal expert predetermine questions to be asked prior to the fieldwork, setting up the research design. When this is not feasible, careful recovery of all faunal material by the archeologist is normally sufficient. An analytic approach based on predetermined questions is better than one based on the faunal collection itself. Questions about the aboriginal animal uses guided our investigation. This appendix first systematically describes the fauna recovered at each site, then discusses paleoenvironmental and cultural interpretations of the sample.

TAXONOMY

Although faunal remains have been reported from a fair number of archeological sites in the Sonoran Desert, few have been thoroughly analyzed.

The faunas cited here are included for one of three reasons: (1) they were recovered from sites within the Papagueria proper, near our own sites (Valshni Village, Ventana Cave); (2) they are important sites pivotal to our understanding of the prehistory of southern Arizona (San Cayetano, Snaketown, Escalante Ruin); or (3) they produced particularly well-preserved faunas (Rampart Cave, Gypsum Cave).

Only one non-cultural fauna is included for comparison, the packrat middens from southwestern Arizona investigated by Van Devender (1973). These middens yielded carbon-14 dates ranging in age from full-glacial (30,000 B.P.) to post-glacial (2710 B.P.). Van Devender concluded, on the basis of his materials, that little change had taken place in the fauna during the past 11,000 years.

Each single specimen was identified to the lowest possible taxonomic category on the characters present on that specimen alone. When identifications were uncertain, but at least suggested by the material, the abbreviation cf. precedes the uncertain identification. Uncertainty was usually due to one of two factors. Either the fragment did not evince a sufficient number of characters of diagnostic value, or I was not able to compare the specimens in question to all of the species possibly represented. As identification of a specimen proceeded, a close match was often obtained with one of the first comparative specimens examined. When this occurred, the specimen was, nevertheless, compared with all the remaining possibilities to make the identification as certain as possible.

When a particular species was difficult to identify, I have listed the diagnostic characters for the specimens in question. Often only a part of the remains known to pertain to one of two closely related taxa could be clearly identified. In the case of the rabbits, for example, 220 bones could be identified only as lagomorph, while 94 specimens could be placed at the species level.

All species identified at Project sites are presented in our Taxonomic List. The systematics which follows includes the material upon which each faunal identification was based, the animal's present distribution and occurrences of our identified animals at other Arizona sites.

Table 20 TAXONOMIC LIST

Amphibia:

Bufo alvarius	Colorado River Toad
Bufo cf. cognatus	Great Plains Toad
Bufo sp.	

Reptilia:

Kinosternon sp.	Mud Turtle
Gopherus agassizi	Desert Tortoise
Dipsosaurus dorsalis	Desert Iguana
Sauromalusobesus	Chuckwalla
Heleoderma suspectum	Gila Monster
Crotalus atrox	Western Diamondback Rattlesnake
Crotalus mitchelli or C. scutulatus	Speckled or Mohave Rattlesnake
Pituophis melanoleucus	Bull Snake

Mammalia:

Lepus alleni	Antelope Jackrabbit
Lepus californicus	Blacktailed Jackrabbit
Sylvilagus cf. audubonii	Desert Cottontail
Spermophilus terticaudus	Round-tailed Ground Squirrel
Thomomys bottae	Valley Pocket Gopher
Dipodomys cf. merriami	Merrimam's Kangaroo Rat
Neotoma cf. albigula	White-throated Wood Rat
Canis latrans	Coyote
Canis sp.	Dog/Coyote
Urocyon cinereoargenteus	Gray Fox
Taxidea taxus	Badger
Felida indeterminate	Cat, likely Felis concolor, the puma
Odocoileus cf. hemionus	Mule Deer

Aves:

Lophortyx gambelii	Gambel's Quail
Bubo virginianus	Great Horned Owl
cf. Colaptes auratus mearnsi	Mearn's Flicker

SYSTEMATICS

Bufo alvarius Girard. Colorado River Toad.

Material examined: left dentary, H-175-250-1 from Az.Z:11:5.

Widely distributed statewide in the desert parts of the Upper and Lower Sonoran life zones; found on widely varied soils (Lowe 1964a: 155-6). Remains of this toad have not been reported from other sites in the Sonoran Desert.

Bufo cf. cognatus Say. Great Plains Toad.

Material examined: two ilia; two humeri; two tibia-fibulae; one calcaneum; representing two individuals, one from Az.Z:14:21 (15c-187-121-4) and one from Az.Z:14:33 (32a-72-79-8).

Upper and Lower Sonoran life zones, in both desert and grasslands. Not dependent upon permanent water. Not reported from other sites in the Sonoran Desert.

Bufo sp. Indeterminate toad.

Material examined: humerus, from Az.Z: 14:21 (15-TP3-5); humerus, from Az.Z:14:33 (32a-72-79-9); and a fragmentary urostyle from Az.Z:14:33 (32a-70-75-3).

These elements could not be matched exactly with the comparative materials available and are, therefore, listed as Bufo sp.

Kinosternon sp. Mud Turtle.

Material examined: three fragments of carapace from Az.Z:14:21 (15-TP3-9, 15-TP3-10, 15c-118-128-4) and four fragments of carapace from Az.Z:14:33 (32a-68-73-3, 32a-70-75-1, 32a-50-75-2, 32a-70-73-2). Identified elements include the third left peripheral, ninth left peripheral, and costal bone fragments.

There are two species included within this genus: Kinosternon flavescens, the Yellow Mud Turtle, found primarily in the Upper Sonoran desert-grasslands of Cochise and Pima Counties near permanent or temporary

waters and Kinosternon sonoriense, the Sonoran Mud Turtle, commonest along permanent and semipermanent streams in the Upper and Lower Sonoran life zones, particularly in the Arizona Upland desert and in oak woodland (Lowe 1964a: 158-159). It seems likely, given the ecological preferences of the two species, that K. flavescens is the species present in our collections. However, the material present is not adequate to make the distinction. Kinosternon has been recovered from a number of sites in the Sonoran Desert including Escalante Ruin (Sparling 1974: 222).

Gopherus agassizi Cooper. Desert Tortoise.

Material examined: one carapace fragment from Pit House 1 at Az.Z:11:5 (HPHI-7-4); one carapace fragment from Az.Z:11:5 (H-125-215-1); one carapace fragment and one humerus from Az.Z:14:21 (15c-121-126-3, 15c-119-123-1); and six carapace fragments, one plastron fragment and one humerus from Az.Z:14:33 (32a-66-70-1, 32a-68-73-3, 32a-70-77-5, 32a-70-77-6, 32a-68-79-4, 32a-68-73-1, 32a-68-73-1 and 32a-68-71-2).

The Desert Tortoise is primarily a Lower Sonoran animal, and is commonest in rocky foothills (Lowe 1964a: 159). Desert Tortoise, under the name Gopherus berlandieri, was reported for the upper midden at Ventana Cave (Haury 1950: 152). Gopherus agassizi was reported from Rampart Cave in northern Arizona (Wilson 1942). Tortoise remains have also been recorded at Gypsum Cave (Brattstrom 1954: 12) and at Ramanote Cave (DiPeso 1956: Fig. 70).

Dipsosaurus dorsalis Baird and Girard. Desert Iguana.

Material examined: one femur and one pelvis from Az.Z:11:5 (H-165-255-2, H-170-225-2) and 1 tibia from Az.Z:14:33 (32a-70-77-5).

Widely distributed and abundant throughout the Lower Sonoran life zone, especially where creosotebushes (Larrea divaricata) are present (Lowe 1964a: 160). This lizard has not been reported from other sites in the Sonoran Desert.

Sauromalusobesus Baird. Chuckwalla.

Material examined: left dentary from Az.Z:14:33 (32a-58-79-3).

Common in the western portion of the state in rock areas of the lower Sonoran life zone (Lowe 1964a: 160). The Chuckwalla has been reported from Gypsum and Rampart Caves in northern Arizona (Brattstrom 1954: 9; Wilson 1942) as well as from post-glacial packrat middens from south-western Arizona (Van Devender 1973: 150).

Heleoderma suspectum Cope. Gila Monster.

Material examined: one left maxilla with the bases of teeth and four ossicles from the dermal armor, from Az.Z:14:33 (32a-70-77-10).

The Gila Monster is found in rocky areas of the Lower Sonoran and Upper Sonoran life zones; winter dens are frequently near those of Crotalus atrox. Gila Monster remains have been reported from Gypsum Cave (Brattstrom 1954: 10) and from Ventana Cave under the name Heleoderma maculatum (Haury 1950: 152).

Crotalus atrox Baird and Girard. Western Diamondback Rattlesnake.

Material examined: two vertebrae from Az.Z:14:21 (15-TP3-10, 15c-119-128-2) and nine vertebrae from Az.Z:14:33 (32a-70-75-3, 32a-70-75-7, 32a-70-75-8, 32a-40-77-5, 32a-70-77-8, 32a-70-77-11, 32a-70-77-12, 32a-72-79-2 and 32a-72-79-4).

Common throughout the Upper and Lower Sonoran life zones in a variety of habitats. Vertebrae of this species are easily recognizable because of their large size and typical crotalid morphology. Western Diamondbacks have been recorded from Gypsum Cave (Brattstrom 1954:11-12) and possibly from the Escalante Ruin, where snakes have been identified as crotalid, but no species assigned (Sparling 1974).

Crotalus mitchelli or Crotalus scutulatus Speckled Rattlesnake or Mohave Rattlesnake.

Material examined: one vertebra from Az.Z:11:5 (H-160-205-2); one vertebra from Az.Z:14:33 (32a-70-77-12).

C. mitchelli is normally found in rocky areas like that around Az.Z: 11:5 (Lowe 1964a:173). The two vertebrae in question could not be identified with certainty as either one of the two named species; they definitely do not represent any of the other species of Crotalus from the Sonoran Desert. It may be suggested that both species are represented because of the difference in local environment between the two sites and the known habitat preferences of the two species. Crotalus mitchelli was found at Gypsum Cave (Brattstrom 1954:11).

Pituophis melanoleucus Daudin. Bullsnake or Gopher Snake.

Material examined: one vertebra from Az.Z:14:33 (32a-70-77-10).

This snake is common statewide in "greater ecological range and wider geographical distribution than any other reptilian species occurring in Arizona" (Lowe 1964a: 169).

Lepus alleni Mearns. Antelope Jackrabbit; Lepus californicus Gray. Black-tailed Jackrabbit.

Material examined: L. californicus: 24 elements, including mandibles, maxillae, distal tibiae, clacanea and astragali, from Az.Z:14:28, Az.Z: 14:30, Az.Z:14:21, and Az.Z:14:33. L. alleni: 56 elements, including mandibles, maxillae, humeri, distal tibiae, calcanei and astragali, from Az.Z: 14:21 (39 fragments), Az.Z:14:28 (two fragments), Az.Z:14:30 (six fragments), Az.Z:14:33 (six fragments) and Pit House 1 at Az.Z:11:5 (three fragments).

These two jackrabbits have overlapping ranges, L. californicus is found throughout Arizona while L. alleni is restricted to the central one-third of Southern Arizona (Cockrum 1964: 251). Differentiating the two species on the basis of skeletal characteristics present on bone fragments is difficult at best, even when comparative skeletons are available. L. alleni, when fully adult, is usually much larger than the corresponding L. californicus adult. Thus, because of their large size, 24 elements were segregated from the collection as L. alleni. The remaining large lagomorph material, 56 elements, was identified as L. californicus, even though it is likely that this category includes some smaller examples of L. alleni.

Jackrabbit remains have been reported from a number of sites in the Sonoran Desert, including: Ventana Cave upper midden (*L. alleni* and *L. californicus*, Haury 1950:151), Ventana Cave volcanic debris (*L. alleni*, Haury 1950:128); Valshni Village (*L. alleni* and *L. californicus*, Withers 1944:34), Escalante Ruin (*Lepus* sp., Sparling 1974), packrat midden in southwestern Arizona (*Lepus* sp., Van Devender 1973: 141), Snaketown (*L. californicus*, Haury 1937: 156), Rampart Cave, Arizona (*Lepus* cf. *californicus*, Wilson 1942), and Ramanote Cave and San Cayetano Village (*L. alleni* and *L. californicus*, DiPeso 1956: Fig. 79).

Sylvilagus cf. *audubonii* Baird. Desert Cottontail.

Material examined: 14 elements, including mandibles, maxillae, distal humeri, distal tibiae and one calcaneum, from Az.Z:14:21 (nine elements), Az.Z:14:31 (one), Az.Z:14:33 (three) and Pit House 1 at Az.Z:1:5 (one).

These 14 elements were separated from the remainder of the lagomorph material because of their small size when compared to any of the rabbits in the genus *Lepus*. Although all pertain to skeletally adult animals, they were from 30 to 60% smaller than the corresponding bone in *L. alleni*. They were judged closest in size and morphology to *Sylvilagus audubonii*, the Desert Cottontail; it is possible that they pertain to one of the other two rabbits from Arizona, *Sylvilagus nuttali*, Nuttal's Cottontail, or *S. floridanus*, the Eastern Cottontail. The bones from our sites are therefore referred only provisionally to *S.* cf. *audubonii*.

Sylvilagus audubonii is common throughout the state at elevations of less than 6,000 feet (Cockrum 1964: 252). Cottontail remains have been reported at Ramanote Cave (DiPeso 1956: Fig. 70), San Cayetano Village (DiPeso 1956: Fig. 70), Ventana Cave, upper midden (Haury 1950:151); Valshni Village (Withers 1944:34), Snaketown (Haury 1937: 156), Escalante Ruin (Sparling 1974), and Van Devender's packrat middens in southwestern Arizona (1973: 157).

Lagomorph, indeterminate

Material examined: A large number of bones (220) were identified as lagomorph but were not identifiable with certainty to genus. Compared to bones that were identified, it is likely that 15% are from *Sylvilagus* and 85% from *Lepus*; also, most of the fragments seem too large to pertain to *Sylvilagus*.

Spermophilus tereticaudus Baird. Round-tailed Ground Squirrel.

Material examined: one palate with BM3, RM2-3 from Az.Z:11:5 (H-175-205-1); one maxilla fragment with LP4-M1 from Az.Z:14:21 (15-TP3-8); one left mandible with P4 from Pit House 1 Az.Z:11:5 (HPH1-7-4); five femora from Az.Z:14:21 and Az.Z:14:33 (15c-187-117-3, 15-TP3-10, 32a-68-75-2, 32a-72-79-3, 32a-70-77-wall scrapings, 32a-70-77-14); three humeri from Az.Z:14:33 (32a-70-77-11, 32a-70-75-8, 32a-68-77-8); and one ulna from Az.Z:14:32 (32a-70-79-8).

Cockrum (1964: 252) stated that this animal is common in the southwestern part of the state in the Lower Sonoran life zone. This ground squirrel has not been reported from any other archeological sites in the Sonoran Desert, but it has been recovered in a post-glacial packrat midden in the Tucson Mountains (Van Devender 1973:146).

Thomomys bottae Eydoux and Gervais. Valley Pocket Gopher.

Material examined: two mandibles from Az.Z:14:21 (15-TP3-8, 15-TP3-10, 15c-189-110-4); two from Az.Z:14:33 (32a-70-77-12, 32a-72-79-8); and one from Pit House 1 at Az.Z:11:5 (HPH1-4-1).

The mandibles from this rodent were identifiable on the basis of the alveoli for the hypsodont teeth and the characteristic body thickening of the horizontal ramus. The Valley Pocket Gopher is found at all elevations throughout the state (Cockrum 1964: 253).

Valley Pocket Gopher remains have been reported from Pleistocene packrat middens in southwestern Arizona (Van Devender 1973), from Snaketown (*T. cervinus* Haury 1937: 156), Ventana Cave upper midden (*Thomomys* sp., Haury 1950: 151) and the Escalante Ruin (Sparling 1974).

<u>Dipodomys</u> cf. <u>merriami</u> Mearns. Merriam's Kangaroo Rat.

Material examined: one premaxilla with incisor from Az.Z:14:33 (32a-68-69-7); four femora from Az.Z:14:33(32a-72-79-6, 32a-70-77-11, 32a-70-77-13, 32a-70-77-11); and four tibiae from Az.Z:14:21 (15c-121-126-2) and from Az.Z:14:33 (32a-70-77-13, 32a-70-77-10, 32a-72-79-6).

This animal is presently found in the western and southern parts of Arizona (Cockrum 1964: 254). Remains have been reported for both Pleistocene and post-Pleistocene packrat middens in southwestern Arizona (Van Devender 1973), and from the archeological sites of Ventana Cave (<u>Dipodomys</u> sp., Haury 1950: 151), Escalante Ruin (<u>Dipodomys</u> <u>ordi</u>, Sparling 1974) and Snaketown (<u>Dipodomys</u> sp., Haury 1937: 156).

<u>Neotoma</u> cf. <u>albigula</u> Hartley. White-throated Wood Rat.

Material examined: left mandible with M1-3, from Az.Z:14:21 (15c-187-121-6).

Common throughout the state according to Cockrum (1964: 256). <u>Neotoma</u> has been reported from both Pleistocene and post-Pleistocene packrat middens from the Sonoran Desert (Van Devender 1973) as well as from the archeological sites of Snaketown (<u>Neotoma</u> cf. <u>albigula</u>), Ventana Cave upper midden (<u>Neotoma</u> sp.) and Escalante Ruin (<u>Neotoma</u> <u>albigula</u>) (Haury 1937: 156; Haury 1950: 151; Sparling 1974).

<u>Canis</u> <u>latrans</u> Say. Coyote.

Material examined: right and left mandibles from a single individual, from Az.Z:14:33 (32a-68-71-1).

Identified as coyote on the basis of the lower carnassial's slenderness and the paraconid's form. It should be noted that coyote remains are rather easier to separate than dog and wolf remains. The jaws in the present specimen were quite broken and could not be sufficiently restored to allow the application of Lawrence and Bossert's (1967) multivariate discrimination. Coyote remains have been identified from Ventana Cave (Haury 1950: 151), Valshni Village (Withers 1944: 34) and Snaketown (Haury 1937: 156).

Canis sp. dog/wolf.

Material examined: one glenoid area of skull, left side, from Az.Z: 14:21 (15c-191-123-1); one fragment of right mandible with alveolus for carnassial from Az.Z:14:21 (15c-187-119-1).

These specimens are both too large to pertain to any of the foxes and are, therefore, referred to as Canis sp. In proportion, they differ from the coyotes available for comparison; instead it is likely that they represent either the wolf or a domestic dog. Remains identified as Canis sp. are reported from nearly all sites where bone was found.

Urocyon cinereoargenteus Schreber. Gray Fox.

Material examined: fragment of the left lower mandible including the alveoli for the lower carnassial, from Az.Z:14:21 (15c-177-121-1).

This specimen matches exactly in form and measurement a specimen of U. cinereoargenteus scottii from Pima County, Arizona, in the University of Arizona Department of Mammalogy collections. It is common statewide (Cockrum 1964: 257). Gray fox bones have been recorded from Snaketown (Haury 1937: 156), Ventana Cave upper midden (Haury 1950: 151) and Escalante Ruin (Sparling 1974).

Taxidea taxus Schreber. Badger.

Material examined: a left mandibular ramus with alveolus for the carnassial, from Az.Z:14:21 (15c-189-121-2).

This fragment was identified as badger based on the following characteristics: robustness of the mandibular body, relative thickness of the mandible, shape of alveolus for the carnassial and the configuration of the masseteric fossa. Remains of this animal, common statewide today, have been recovered from Ventana Cave (T. t. verlandieri, Haury 1950: 151) and Ramanote Cave (T. taxus, DiPeso 1956: Fig. 70).

Felida, indeterminate.

Material examined: one first phalange from Az.Z:11:5 (H-170-2051).

This single specimen can be identified as felid on the basis of the curvature of the phalange. It most clearly approximates the size of a large *Lynx* or a small *Felis concolor*, both of which are reported from the general area of the sites (Cockrum 1960; Figs. 105, 106). *Felis concolor* is reported from Rampart Cave (Wilson 1942) and Ventana Cave upper midden (Haury 1950: 151), while *Lynx* remains have been recovered at Valshni Village (Withers 1944: 34) and Rampart Cave (Wilson 1942).

Odocoileus cf. *hemionus*.

Material examined: 19 elements, including nine bone awl fragments made on metapodial fragments (see section on bone tools); one antler fragment, one scapula fragment, two rib fragments and a vertebra, all from Az.Z:14:33 (32a-68-71-1, 32a-79-75-3, 32a-70-77-wall scraping, 32a-70-77-wall scraping and 32a-70-75-3); a distal tibia, proximal second phalange, rib fragment and an ulna fragment, all from Az.Z:14:21 (15c-189-121-1, 15c-191-123-1, 15c-189-121-2, 15c-187-119-4).

Both the white-tailed deer (*O. virginianus*) and the mule or black-tailed deer (*O. hemionus*) are reported from the Papagueria. Deer bones, of one or both species, are reported from most archeological sites. Specific identifications based upon adequate samples are possible with archeological materials; however, such identifications, particularly in the older literature, are to be suspected unless the published report indicates the basis upon which the identifications were made.

Carnivora.

Material examined: eight elements, including five phalanges from Az.Z:14:33 (32a-72-79-9, 32a-72-79-6, 32a-72-79-3, 32a-72-79-3), one metapodial from Az.Z:14:33 (32a-72-79-6), one fragment of lower carnassial from Az.Z:14:33 (32a-72-79-10) and one fragment of ulna from Az.Z:14:21 (15c-121-126-3). Because of the fragmentary and non-diagnostic nature of these remains, they cannot be assigned to a taxonomic category lower than "carnivora."

Lophortyx gambelii Gambel. Gambel's Quail.

Material examined: one humerus lacking articular surfaces but preserving brachial depression, from Az.Z:11:5 (H-165-215-12).

Gambel's Quail is common throughout the southern half of the state; its extension into northern Arizona is likely a recent phenomena (Monson and Phillips 1964: 192). Gambel's Quail was reported from Escalante Ruin (Sparling 1974: 222) and Ventana Cave upper midden (Haury 1950: 152).

Bubo virginianus Gmelin. Great Horned Owl.

Material examined: one complete left carpometacarpus from Pit House 1, Az.Z:11:5 (HPH1-11-2).

This large owl is common throughout the state all year long, except in the densest forests (Monson and Phillips 1964: 201). Bones attributed to this species were recovered at Babocamari Village (DiPeso 1951: 113), Ventana Cave upper midden (Haury 1950: 152), and Snaketown (owl sp., Haury 1937: 156).

Calaptes auratus Linnaeus. Flicker.

Material examined: distal 1/2 of left ulna from Pit House 1, Az.Z: 11:5 (HPH-1-5-1).

There are at least four varieties of the woodpecker based on color differences. All are considered conspecific in Phillips, Marshall and Monson's compendium on Arizona birds (1964: 68). Mearns' flicker, (C. a. mearnsi) has a present day distribution covering most of the Papagueria as defined in this volume. Comparison with available specimens of mearnsi, lutens and collaris show our specimen closest in size and morphology to mearnsi. Flicker remains have not been reported from any of the sites known to the author.

Quail, undetermined.

Material examined: Right proximal humerus, from Az.Z:14:21 (TP-3-11), complete left femur from Az.Z:14:21 (TP-3-7), and a distal 1/2

tibiotarsus from Az.Z:14:33a (32a-70-77-6). These elements are referrable to any one of three genera: Lophortyx, Callipipla or Colinus. It is possible to say that none is from Cyrtonyx.

PALEOECOLOGICAL INTERPRETATIONS

Vertebrate faunas have long been used by paleontologists as a means of reconstructing the environment at the time the animals lived. Such a procedure is based upon the assumption that the species present in a fauna all lived at the same time and within a short distance of the site of deposition. For archeological fauna, the interpretation is further complicated because human behavior, not the behavior or ecological requirements of the animals themselves, can be responsible for bone occurrence in an archeological context. It is true that people could not have collected animals that were absent from their environment; however, the absence of a given species from an archeological assemblage does not necessitate its absence from the environment. Furthermore, changes in faunal composition must be very cautiously interpreted, since such changes may either be due to environmental change (that is, change in the natural faunal composition) or equally to changing human dietary practices not dependent on real faunal change.

In the case of the Quijotoa faunas, little can be said about environmental change. In fact, the faunas support Van Devender's contention (1973) that little change in the fauna of the Sonoran Desert has taken place in the past 11,000 years. All species recovered still live in the area today.

Both long and short term fluctuations in abundance and local distribution have certainly taken place; the near extinction in recent years of the larger cats (Felis concolor) and the increasing rarity of the mountain sheep (Ovis canadensis) and the pronghorn (Antilocapra americana) can be cited as examples. With certain of the animals exploited prehistorically, yearly variation in abundance could have been critical. Well dated archeological faunas will certainly contribute data relevant to questions concerning the biogeographic history of the Sonoran Desert.

CULTURAL INTERPRETATIONS

Tables 21 to 24 detail the fauna recovered from each of the sites and are summarized in Table 26. Since only four sites produced appreciable amounts of animal bone, Az.Z:14:21, Az.Z:14:30, Az.Z:14:33 and Az.Z:11:5 (including Pit House 1); discussion of the cultural implications of the faunas will be largely limited to these sites.

Question: What animals were eaten by the inhabitants of these sites, what was the relative importance of the various species? Data appropriate to this question are presented in tables. The identifications themselves indicate the animals that were being brought into the site were for consumption. The assumption is made here that the bones all represent animals intended for food use, and that none of the material is incidental or intrusive; an assumption that is almost certainly not true. However, the animals present in the largest numbers are assumed to have been food animals; those occurring with less frequency may have become incorporated into the deposit either as a result of cultural activities other than subsistence, or they may be post depositional intrusives. Although Thomas (1971) has presented a method of distinguishing cultural from noncultural bone assemblages, his method does not seem applicable to small samples or to distinguishing between cultural and non-cultural bone within the same archeological units.

The relative importance of the species present can be judged in one of three ways. One can compare the number of specimens identified in each category (as did Thomas for his Great Basin faunas: Thomas 1969). The minimum number of individuals needed to account for all the bones recovered can be calculated as the basis for comparison (a method first devised for use by vertebrate paleontologists: Shotwell 1955, 1956, 1958; and later adopted by the archeologists: T. White 1953; Flannery 1967; Grayson 1973). Finally, one can also calculate the potential meat weight represented by the number of individuals present, either in terms of absolute numbers (against which Guilday (1970) has presented an eloquent and convincing argument) or in terms of the relative contribution of each species,

Table 21 FAUNA RECOVERED AT Az.Z:11:5 and PIT HOUSE 1

Taxon	LEVELS Surface	1	2	3	4	Total
Az.Z:11:5 Hickiwan Village						
Turtle	-	21	4	-	-	25
Lagomorph	1	5	9	6	-	21
Rodent	-	-	2	-	-	2
Bird	-	-	2	-	-	2
Crotalus mitchelli; or *C. scutulatus*	-	-	1	-	-	1
Felida indeterminate	-	1	-	-	-	1
Dipsosauras dorsalis	-	1	-	-	-	1
Ammo otospermophilus	-	1	-	-	-	1
Bufo alvarius	-	1	-	-	-	1
Indeterminate scrap	1	120	55	-	-	176
Total number of bones examined:						231
Total number of bones identified:						(23.8%) 55
Az.Z:11:5 Pit House 1						
Lagomorph	-	39	5	3	1	48
Rodent	-	3	-	-	1	4
Turtle	-	-	-	2	1	3
Amphibian	-	-	1	-	-	1
Bird	-	1	-	-	-	1
Indeterminate scrap	-	12	25	8	9	54
Total number of bones examined						111
Total number of bones identified:						(51.4%) 57

Table 22 FAUNA RECOVERED AT Az.Z:14:21 and Az.Z:14:28 Loci A & B

	LEVELS											
Taxon	1	2	3	4	5	6	7	8	9	10	11	Total
Az.Z:14:21												
Lagomorph	44	29	43	25	13	3	5	4	-	3	1	170
Turtle	4	2	5	6	-	-	-	2	-	-	-	19
Rodentia	3	2	1	2	-	1	-	2	-	3	-	14
Artiodactyla	3	3	-	2	-	-	-	-	-	-	-	8
Bufo cognatus	-	-	-	6	-	-	-	-	-	-	-	6
Crotalus atrox	-	-	1	-	-	-	-	-	-	-	-	2
Carnivore	2	-	-	-	-	-	-	-	-	-	-	2
Neotoma sp.	-	-	-	-	-	1	-	-	-	-	-	1
Indeterminate bird	-	-	-	-	-	1	-	-	-	-	-	1
Indeterminate scrap	223	131	131	83	56	19	19	3	6	8	-	679
Total number of fragments examined:												902
Fragments identified												(13.7%) 124
Az.Z:14:28 A & B												
Lagomorph	1	3	1	-	-	-	-	-	-	-	-	5
Rodent	-	-	-	-	1	-	-	-	-	-	-	1
Amphibian	-	-	1	-	-	-	-	-	-	-	-	1
Indeterminate scrap	1	3	4	3	2	-	-	-	-	-	-	13
Total number of bones examined:												20
Bones identified:												(35%) 7

Table 23 FAUNA RECOVERED AT Az.Z:14:30, Az.Z:14:31, and Az.Z:14:32

	LEVELS						
Taxon	Surface	1	2	3	4	5	Total
Az.Z:14:30							
Lagomorph	1	6	5	2	4	1	19
Indeterminate scrap	2*	15	13	27	16	7	80
Total number of bones examined							100
Bones identified:							(19%) 19
*Feature 1: 1 indeterminate scrap							
Az.Z:14:31							
Lagomorph	–	5	5	–	–	–	10
Indeterminate scrap	–	–	14	–	–	–	14
Total number of fragments examined:							24
Fragments identified:							(41.7%) 10
Az.Z:14:32							
Lagomorph	–	–	1	–	–	–	1
Indeterminate scrap	–	15	11	7	2	–	35
Total number of fragments examined:							36
Fragments identified:							(2.8%) 1

Table 24 FAUNA RECOVERED AT Az.Z:14:33

Taxon	LEVELS															
	Surface	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Az.Z:14:33																
Turtle	2	18	15	9	6	1	4	2	-	-	-	-	-	-	-	53
Lagomorph	1	1	1	1	3	2	6	4	5	4	5	2	-	4	-	40
Rodent	2	1	3	2	2	2	8	2	5	1	1	5	-	2	3	39
Crotalus atrox	-	-	1	1	1	1	-	1	2	-	-	1	1	-	-	9
Artiodactyla	2	1	1	2	-	-	-	-	-	-	-	-	-	-	-	6
Carnivora	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	3
Bird	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2
Bufo sp.	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	2
Canis sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Reithrodontomys	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Sauromalus obesus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Pitulophis melanoleucus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Heleoderma suspectum	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Canis latrans	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Bufo cognatus	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Dipsosaurus dorsalis	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Crotalus mitchelli C. scutulatus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1

Bones examined: (31.4%) 526

Total number of bones identified: 165

Table 25 FREQUENCY OF IDENTIFIED SPECIMENS

Taxon	Frequency	Percentage
Lagomorph	314	58.4%
Turtle	103	19.1%
Rodent	63	11.7%
Snake	14	2.6%
Cervid	14	2.6%
Amphibian	12	2.2%
Carnivore	7	1.3%
Bird	6	1.1%
Lizard	4	0.8%
Felid	1	0.2%
Sub-Total	538	100.0%
Scrap	1,576	
Total number of bones examined	2,114	

usually presented in percentage terms (Perkins 1973; Hesse and Perkins 1974; White 1974, 1975).

I have recorded incidence of charred or calcined bones. Those species consistently represented by fire-affected material are assumed to have been food items. Species not represented by charred or calcined materials may either have been cooked in such a way that they were not exposed to open fire (i.e., boiled in a ceramic vessel) or they may have been non-food or even non-cultural items. Two categories, lagomorph (including *Lepus alleni*, *Lepus californicus* and *Sylvilagus* cf. *auduboni* as well as lagomorph material not attributable to a given species) and turtle (including *Kinosternon*, the mud turtle, as well as *Gopherus agassizi*, the desert tortoise) had high percentages of charred or calcined bones. It is these two categories that provided most of the potentially available animal protein.

Questions: Where were these animals hunted, how were they hunted, and in what way were they butchered and cooked? Few data appropriate to these questions were provided by the analysis. First, the sites are located in what can be modeled as a homogeneous environment, without significant variation in the concentration of animal populations, at least those identified in these faunas. Most of the hunting of these animals was likely done within a radius of a few kilometers of the sites. Rea (1974) has noted that agricultural activities among the Pima Indians tends to increase local abundance of jackrabbit and cottontail. If the inhabitants of these sites were doing any agriculture at all, this may have been a significant factor.

In an attempt to derive information about butchering and cooking, a detailed examination was made of the bone's state of preservation. Table 27 presents the data from this analysis for the rabbit materials and Table 28 for the turtle remains. As the bone material was handled, four categories were obvious to visual inspection.

1. *Unburned bone*. Bone in this category was a very light color and a porous texture. The interior of the bone might be slightly lighter in color when exposed by a fresh break. In addition, this bone tended to be very lightweight compared to the other categories.

2. <u>Brown-burned bone</u>. Bone in this category varied from just slightly darker than category 1 to a deep, rich brown color. Surfaces tended to be very well preserved and shiny. Some of the bone in this category felt as if it were partially mineralized.
3. <u>Black-burned bone</u>. Bone in this category was black, with a powdery, charred appearance. About half of the bone in this category seemed dense and shiny with hard, well preserved surfaces, while the remainder most closely resembled charcoal, with a powdery, soft, friable aspect.
4. <u>Calcined bone</u>. Bone which has been calcined has a soft, white, chalky appearance. Usually only limited portions of a given fragment were calcined, but in a number of cases the entire fragment was calcined completely.

After the bone had been divided into these categories, it was evident that considerable intergrading was present. Bones often showed all four conditions present on a single fragment. It was hypothesized that the four categories represented a continuum with increased temperature and time of exposure the controlling factors. For this reason, the bones were divided a second time with a given fragment being assigned to the highest temperature-time category possible. Thus, a fragment which had both brown-burned and black-burned areas was classified as a black-burned one. It must be emphasized that the ordering of these categories stands as an assumption and has not been verified through experiment.

Because of the small size of our samples, only tentative conclusions can be drawn about the bone's preservation; these conclusions can serve as hypotheses to be tested when faunal remains are recovered from additional work.

1. The highest frequency of fire exposure occurs on the scapula, humerus, ulna, tibia, calcaneum and astaragalus. One, therefore, would expect that these are the elements that are either being exposed to the roasting fire because of butchering or that the less frequently burned elements are protected from exposure by thick coatings of meat and/or skin.

2. The lowest frequency of exposure to fire occurs on the pelvis, metapodial and phalange. As mentioned above, the pelvis might have been protected from burning by the covering of meat and/or skin that it bore, but it seems likely that the metapodials and phalanges were not exposed to the fire at all. The former may have been removed incident to skinning, or they may have been removed intentionally since there is no meat on that part of the limb. It is likely that the latter were removed with the skin prior to cooking.

The highest frequency of calcining (category 4) relative to the other categories of fire exposure (2 and 3) occurs on vertebrae and on the calcaneum, while a significant proportion of calcining occurs on the distal tibia as well. This might be expected if the metapodials and phalanges had been cut off before cooking, leaving the distal tibia and the calcaneum, and likely the astragalus, articulated and exposed. Why the vertebrae should so often be calcined is less clear; our sample of vertebrae recovered is small, and this variation could be due to chance alone.

Based on these tentative conclusions, I would reconstruct the butchering and cooking of rabbits as follows. After having been caught, the rabbits were skinned, removing the phalanges and metapodials with the skin. The head seems to have been left on the carcass. The animal was then roasted over an open fire or in the coals and ashes of the hearth. The animal seems to have been roasted whole, rather than being disjointed and roasted piece by piece. The extreme fragmentation of the bones (average weight of 314 pieces = 16 g, average size about 2.5 cm in maximum dimension) may have been due to either scavenging by dogs or to the fact that the relatively delicate bones were broken when the meat was eaten. I favor the latter hypothesis, since not a single bone showed tooth marks or other evidence of dog modification (such modification has been identified at other sites) (P. Johnson 1976: personal communication). This may indicate that dogs were not kept by the prehistoric Papaguerians, although domestic dog remains were recovered from contemporary levels at Ventana Cave (Haury 1950: 157-9).

Not a single fragment in our collection showed any evidence of skinning or butchering cuts. Such cuts should have been visible had they been present because the surfaces are remarkably well preserved. Either the

animals were not skinned and butchered, or such activity was carried out so skillfully that no marks were made on the bones. As noted above, other evidence suggests that the carcasses were not disjointed other than to remove the feet, after which the animal could be easily skinned with stone tools, without scarring the bones.

Castetter and Bell (1942: 57-58), Castetter and Underhill (1935: 40-41) and Rea (1974) remarked on the Papago and Piman Indians' heavy reliance on large mammals for protein. Castetter and Bell (1942): 57-58) commented:

> A family group formerly had no more than one or two hunters each killing about twelve to fifteen deer per year. Many families had no hunter, so that the kill was distributed among the entire economic unit with which they were affiliated, ranging usually from two to ten families.

While deer were said to have been of major importance to the diet, the contribution of antelope and mountain sheep is harder to assess. These animals have become very scarce during recent years, although it is thought that they were formerly much more abundant. Questioning Papago informants, Castetter and Underhill (1935: 41) could find only one Sand Papago who remembered anything about mountain sheep being hunted; other informants stated that antelope was "much more rarely taken" compared to deer.

The inference made from our faunal data that large mammals were not extensively, if at all, utilized in the Quijotoa Valley seems to contradict Castetter and Underhill's ethnohistoric data. Only 19 fragments identifiable as deer were recovered, and nine of these were fragments of bone tools. A few additional fragments, identified only as large mammal, were recovered, most often from a single site, Az.Z:11:5. It would seem as if smaller animals, usually rabbits and turtles, were exploited to the almost complete exclusion of larger forms. This apparent paradox can perhaps be resolved by examining the location of the sites involved and by analogy with ethnohistoric descriptions of Papago Indian settlement patterns.

Hackenberg (1964), utilizing available data, reconstructs the Papago settlement pattern as a seasonal round involving summer settlements near agricultural lands in the valley bottoms, winter well villages and temporary plant exploitation camps. Deer hunting was done mainly from the winter well village, occupied from October through, perhaps July, just after the summer rains. Field villages were occupied from the time of the rains in July until the water supply in the villages failed in September or October. During the stay at the field village, activities centered on agriculture; no organized or solitary hunts for large mammals were conducted.

The sites excavated in the Quijotoa Valley would, on a geographical/topographical basis, fit the summer/fall field village description. They are all located near fairly level, alluvial areas suitable for agriculture. If we hypothesize from the ethnographic data, the following test implications can be constructed:

1. In summer field village faunal remains can be expected to consist of animals other than deer, antelope and mountain sheep; most likely these will consist of jackrabbit, cottontail, rodents, desert tortoise, Gambel's quail and mourning dove (Castetter and Underhill 1935: 40-51).

2. Winter well villages can be expected to produce faunal remains dominated by mule deer, white-tailed deer, antelope and mountain sheep; other animals will be present in relatively much smaller quantities. If large enough samples are recovered, then age-sex composition of the remains can be expected to reflect killing during winter and spring, excluding animals killed between July and September.

3. Provided large enough samples are recovered, the age-sex composition of the kill may be reconstructed. If drive-hunting were practiced, then one would expect a normal distribution in terms of these parameters because the animals taken by such a technique would be a representative sample of the population. A non-normal distribution would point to size selection and presumably a technique involving individual capture.

The results of the faunal analysis support the hypothesis that the sites excavated were summer-occupied field villages. Unfortunately, the collections are too small to support or reject the hypothesis that drive-hunts were used in collecting rabbits.

Table 26 LAGOMORPH ELEMENTS PRESERVED AT Az.Z:14:21 ALL LEVELS, ALL UNITS.

Element	Browned	Charred	Calcined	Plain	Total
Skull	3	1	1	7	12
Mandible	5	2	1	23	31
Vertebra	0	0	1	1	2
Scapula	4	0	6	9	19
Humerus	4	2	2	3	11
Radius	5	1	2	7	15
Ulna	4	1	2	8	15
Pelvis	0	1	0	6	7
Femur	1	0	1	2	4
Tibia	4	2	6	5	17
Calcaneum	1	1	12	8	22
Astragalus	3	0	0	1	4
Metapodials	1	1	0	10	12
Phalanges	2	0	0	3	5

Table 27 BURNED AND NON-BURNED TURTLE BONE FREQUENCY.

Taxon	Burned	(%)	Not burned	(%)
All Sites:				
Kinosternon sp.	2	(25%)	6	(75%)
Gopherus agassizi	7	(29.2%)	17	(70.8%)
Undetermined turtle	28	(62.6%)	17	(37.8%)
Totals	37	(48%)	40	(52%)
Az.Z:14:21				
Kinosternon sp.	9	(75%)	3	(25%)
Gopherus agassizi	2	(40%)	3	(60%)
Undetermined turtle	1	(33.3%)	2	(66.6%)
Totals	12	(60%)	8	(40%)
Az.Z:14:33				
Kinosternon sp.	2	(66.6%)	1	(33.3%)
Gopherus agassizi	5	(35.7%)	9	(64.3%)
Undetermined turtle	17	(51.5%)	16	(48.5%)
Totals	24	(48%)	26	(52%)

Jackrabbit hunting is described by Castetter and Underhill (1935: 42) for the Papago and by Rea (1974) for the Pima. Drive techniques utilized by the Shoshone have been described by Steward (1938). The Papago Indians practice both drive-hunting and individual hunting. One additional point concerning rabbits as food should be made here. Annual rabbit populations fluctuate greatly depending on the rainfall and subsequent green vegetation (Madsen 1974). Agricultural fields would be ideal sources of rabbit food and may have somewhat stablized rabbit populations during years of poor rainfall (Paul Johnson 1976: personal communication).

Since jackrabbits were the major source of animal food utilized at these sites, it is appropriate to examine how they were captured (Fig. 54). Rabbit drives, in which large numbers of animals are taken in a short period of time, were said to have been carried out by the Papago in the spring (Castetter and Bell 1942: 42). This technique involves setting up long, narrow nets in the form of a semicircle, U, or V shape and then having large numbers of people drive the rabbits into the net where they are killed. (See especially the description in Steward 1938: 82-83.) Considerable numbers of animals could be taken in this manner; accounts of historic drives in California indicate capture of over 2,000 rabbits was commonplace.

Limited archeological evidence supports the inference that such drives were practiced in the Papagueria. The fact that considerable reliance was placed upon rabbit meat argues for the development of an efficient hunting technique. When larger faunal samples are available, it may be that the sex-age ratios of the rabbit populations will indicate whether the sample is normally distributed, indicating a catastrophic kill and, therefore, some mass capture technique, or if there has been some selection for size, presumably indicating an individual capture technique.

Kaemlein (1971) describes a hunting net made from human hair and recovered from a cave in the Baboquivari Mountains, well within the Papagueria. The complete net measured 50.2 meters long, 1.1 meter high and weighed 7.4 kilograms. Found with the net were sherds of Tanque Verde

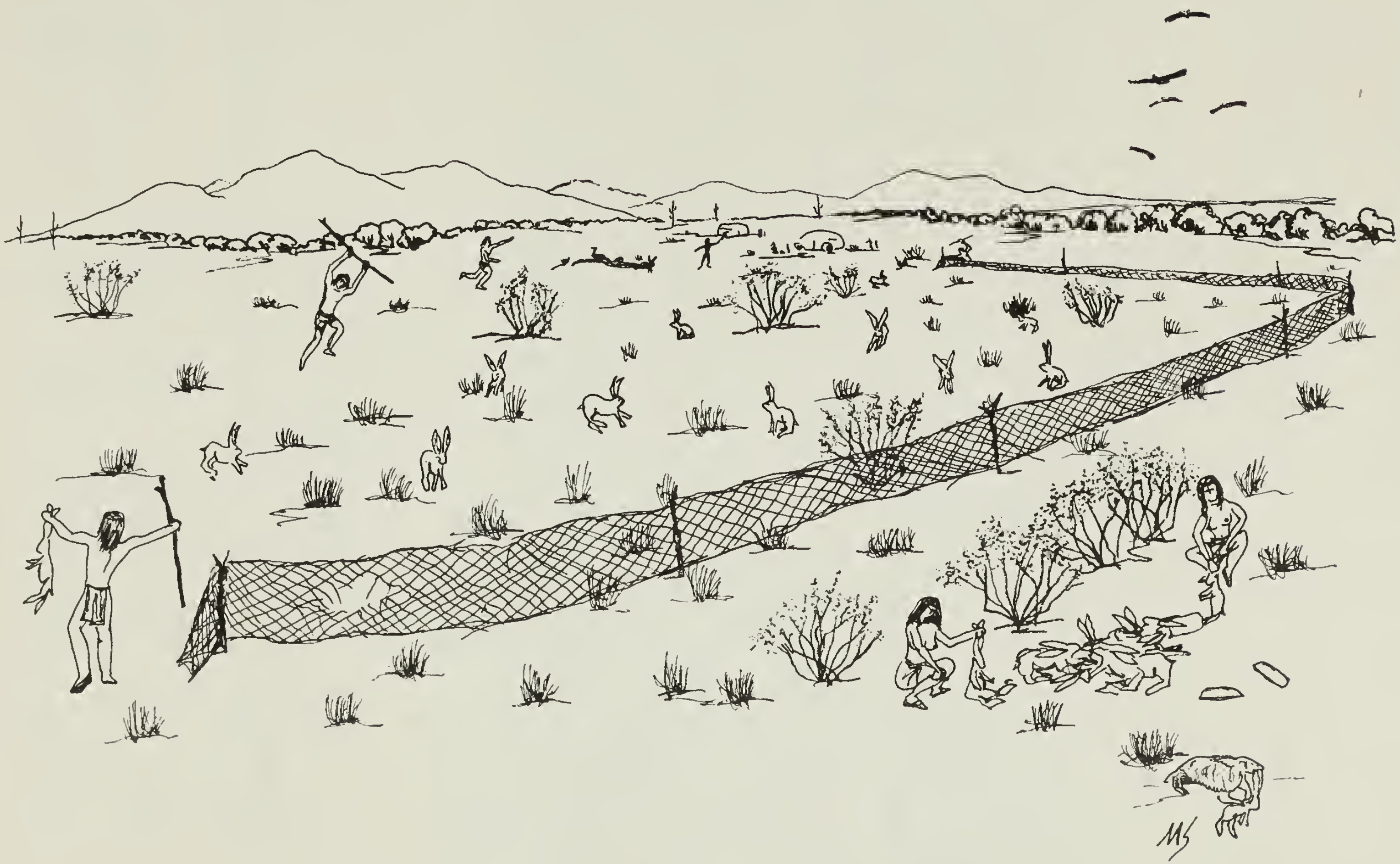

Figure 54. Rabbit hunt.

Red-on-brown pottery, which would date the find at approximately the same time as the Quijotoa Valley faunas.

A second net made from yucca fiber found in a cache in Texas Canyon is also interesting since associated basketry is possible early Papago (Kaemlein 1971: 45). This example was 50.2 meters long, 1.25 meter high and of unknown weight (Kaemlein 1971: 43).

Techniques for hunting rabbits individually are not well described. The use of decoys and calls has been mentioned for the Seri Indians in Sonora (Mary Beck Moser 1975: personal communication) and may well have been practiced in the Quijotoa Valley. Castetter and Underhill (1935: 42) mention Papago boys hunting rabbits as an individual enterprise. One can suppose that hunting of rabbits by youngsters could have been done at any time, but that older individuals whose efforts were required towards agricultural activities seldom would have had the requisite free time to hunt rabbits individually.

Desert quail (Lophortyx) is the only bird in the assemblage likely to have been a regular food source. Castetter and Underhill (1935: 42) mention use of quail for food by the Papago as does Rea (1974: 2) for the Pima. Flicker and owl bones were recovered from Pit House 1 at Az.Z:11:5; both are wing elements (ulna, carpometacarpus). While they may have been eaten, it is equally likely that articulated wings were kept for their feathers.

CONCLUSIONS

The following conclusions summarize the analysis of faunal remains from the Quijotoa valley.

1. Jackrabbits and desert tortoise were the animals most often utilized for food, with no reliance on larger mammals.
2. The sites excavated may have been summer field villages.
3. No major changes in the distribution of the animals present in the faunas have taken place since the occupation of the sites.

APPENDIX II

SOIL ANALYSIS

By

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Four soil samples from two proveniences were submitted to color and mechanical analyses to discern any changes indicative of human occupation. A pH determination was made on a fifth sample. The color analysis was used to determine the soil's nature and condition. The mechanical analysis aided in identifying its particle sizes.

Sample 1 came from within a pot associated with a cremation at Az.Z: 11:5. Sample 2 came from a roasting pit at Son.C:2:20 at a depth of 20 cms. Sample 3 was from level 3 of the pithouse at Az.Z:11:5. The final sample, number 4, was from beneath the roasting pit at Son.C:2:20. The sole pH sample, number 9, was from Az.Z:11:5 pithouse at a depth of 30 cms.

The standard used to determine both color and intensity was the Munsell Soil Colors Chart, which identifies 10 variations of hue, 10 values from dark to pale and 10 qualities of pureness-chroma. The results of the comparison are presented in Table 28. The pH sample was basic, testing in the 8 to 8.5 range.

Table 28 SOIL SAMPLE ANALYSIS

Sample	Color	Sand		Silt		Clay	
	hue/value/chroma	g	%	g	%	g	%
1	10YR6/3	31.4	62.8	11.2	22.4	7.4	14.8
2	10YR6/4	33.4	66.8	11.2	22.4	5.4	10.8
3	10YR5/3	31.6	63.2	10.0	10.0	8.4	16.8
4	10YR6/4	28.4	56.8	11.2	22.4	10.4	20.8

Samples 2 and 4 were identical, yellow-red soils bordering on yellow, with values of 6/10 and chromas of 4/10. The samples may be described as light yellowish-brown soil. Samples 1 and 3 were also yellow-red in hue. Sample 1 had a value of 6, but sample 3 was darker, having a value of 5. The chroma is the same for each, but the colors are less pure than those of the Son.C:2:20 samples. They may be described as pale brown and brown, respectively.

It is thought that yellow to brown soils are distinctive of moister formation conditions, while redder tones are suggestive of dehydration due to soil drought and heat (Cornwall 1958: 182). The co-occurrence of yellow and red soils reflects, perhaps, the effects of human action upon the soil in its archeological context.

A hydrometer was used to quantify the amount of solid material in an aqueous settling solution by measuring density at a stated depth and point in time (Cornwall 1958: 128). A 50 g sample was mixed with distilled water and poured into a graduated cylinder. Then, at intervals, the solution's temperature and density were recorded. The results of the experiment are also presented in Table 28.

Only one sample, number 4, had a significant clay component in the loam. This was the sample from beneath the roasting pit at Son.C:20:2. All other samples were sandy loams.

Soils with loamy textures generally provide an excellent combination of "nutrient reserve and cat-ion exchange capacity, moisture capacity and facility of drainage" (Limbrey 1975: 244), which is very good for cultivation. The agricultural potential of the above samples is, therefore, quite high.

APPENDIX III

ARCHEOLOGICAL POLLEN ANALYSIS IN THE QUIJOTOA VALLEY, ARIZONA

By

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Quijotoa Valley archeological excavations provided an opportunity to examine the pollen record in order to discern how vegetation patterns may have been affected by human cultural activity. The results are especially interesting because this is the first attempt to secure a pollen profile from the region.

Methods

Thirty-one sediment samples were collected from three archeological sites and analyzed by the laboratory of Paleoenvironmental Studies, University of Arizona. One group of samples was removed from the fill of Pithouse 1 at Az.Z:11:5. The two other groups were collected as pollen profiles from the walls of the deepest excavation units at both Az.Z:14:21 and Az.Z:14:33. Sampling intervals were 10 cm, sufficient for most southwestern alluvial samples and probably sufficient for the relatively fine-grained Gu Vo sediments (Mehringer 1967: 135).

The sedimentary profiles are generally homogeneous in texture, being tan to reddish tan, moderately sorted, slightly sticky, slightly firm, nonorganic loamy sand, with a component of gravel which increased at Az.Z:14:33 below 100 cm.

In addition, surface samples were collected from the two Gu Vo sites (Az.Z:11:5 and Az.Z:11:33) as control spectra of the modern pollen rain.

Each surface sample was a mixture of 35 finger pinches of surface material randomly taken from a 100 square meter area.

In order to determine total pollen frequencies, a control tablet containing ca 20,000 (19.900 $\pm$ 1750) Eucalyptus pollen grains was added to each sample after it was oven-dried and weighed to 50 g (Stockmarr 1974).

Then all samples were processed according to a method developed for southwestern alluvium by Peter J. Mehringer, Jr. and Bernard C. Arms at the University of Arizona (Mehringer 1967: 136). The method gives a maximum concentration of the usually sparse fossil pollen by eliminating the mineral and organic components of the relatively large sediment samples. The procedure for extraction consists of (1) gravity separation of light from heavy material with a swirled vortex and decanting, (2) dissolution of carbonates with hydrochloric acid, (3) dissolution of silicates with hydrofluoric acid, (4) removal of organic colloids with hydrochloric and nitric acid and (5) removal of humic acids with potassium hydroxide. Each step is followed by hot distilled water washes and centrifuging. The samples from Az.Z:14:21 were mounted in silicon oil, and those from Az.Z:14:33 and Az.Z:11:5 were mounted in glycerin oil. All samples were stained with basic fuchsin dye.

When the samples were processed and mounted on slides, 200 or more fossil grains were counted on each at 450 X with a binocular microscope, using edge-to-edge transects at established intervals across the cover slip. The exotic Eucalyptus pollen was tabulated along with the fossil pollen, although not included in the pollen sum. The total number of pollen grains in the sample was calculated as follows (Stockmarr 1974):

$$\frac{20{,}000 + \text{No. of fossil pollen grains counted}}{\text{No. of } \underline{\text{Eucalyptus}} \text{ pollen grains counted}} = \begin{array}{l}\text{Total number of pollen}\\ \text{grains per sample}\end{array}$$

The total pollen frequency (Table 29) only records the density of pollen in a measured volume of sediment. It is not to be interpreted as a record of pollen influx (usually expressed as grains cm^{-2} yr^{-1}) which could not be calculated since the time per unit thickness (deposition

time) of the sediments, calculated from an age depth curve and used to correct the pollen density values, was not determined.

After the count, the raw pollen frequencies (Table 29, 30) were converted to percentages. Two percentage tables each were computed for Az.Z: 14:21 and Az.Z:14:33. One table presents the pollen spectra as proportions of the total pollen sum; the other presents the spectra as proportions of the sum split into two classes of taxa according to whether pollination is by wind or animals, in order to reduce the distorting local pollen dispersion effects of the zoogamous plants. The split sum percentage table was diagrammed (Fig. 55).

The Record

The pollen diagram provides a record of that fraction of the original pollen rain remaining at the time a sample is taken and processed. It directly represents the pollen production, dispersion, transportation, deposition and preservation of primarily the local vegetation and secondarily the regional vegetation of the study area. Each step in the history of the pollen rain influences its final appearance on the diagram. A full understanding of the diagram demands an examination of this history, which is usually only partially known.

The pollen diagram primarily elucidates a vegetation record. It seldom directly records environmental factors such as climate, soils or human activity (Faegri and Iversen 1964: 99). Climatic history, for example, can only be inferred from the diagram through knowledge of the way each representative taxon responds to climatic variables and only after some control has been established over other regulating environmental factors which act as "noise" interfering with the climatic "signal."

Pollen Source

All pollen types collected, except pine and oak, are from plants presently living in the immediate area. The sites themselves are located

Table 29 TOTAL POLLEN FREQUENCY

Level (cm)	Pollen grains/g Az.Z:14:21	Az.Z:14:33
0-10	5,200	40,000
10-20	7,454	26,667
20-30	20,000	28,000
30-40	8,000	11,428
40-50	9,467	20,400
50-60	6,154	11,428
60-70	8,000	40,000
70-80	3,636	12,000
80-90	11,500	6,154
90-100	- -	11,428
100-110	- -	13,333
110-120	- -	40,800
120-130	- -	11,428

17,900 $\pm$ 1,750 <u>Eucalyptus</u> gr/tablet

able 30 RAW POLLEN PERCENTAGES FOR Az.Z:14:33

Split Pollen Sum

	Level													
nenophilous Pollen	Surface	23	22	21	20	19	18	17	16	15	14	13	12	11
hort-spine Compositae	62	68	59	59	59	44	51	58	51	52	32	47	41	36
rtemisia	–	–	–	–	–	–	–	–	–	–	–	–	–	–
heno-ams	6	16	18	23	22	25	25	15	22	31	36	24	23	37
raminae	30	14	23	36	19	30	23	26	27	17	33	28	36	25
inus	1	1	1	1	o	1	1	o	1	–	o	o	–	–
uercus	.4	–	–	–	–	–	–	–	–	–	–	–	–	–
phedra	–	1	–	–	o	–	–	–	–	–	–	1	–	1
lantago	.4	–	–	–	1	–	–	–	–	–	–	–	–	1
eltis	1	–	–	–	–	–	–	–	–	1	–	o	–	–
ea mays	–	–	–	1	–	–	–	–	–	–	–	–	–	–
oogamous Pollen														
ong-spine Compositae	51	43	35	17	21	52	34	30	47	43	59	65	45	51
iguliflorae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
idestromia	3	–	–	–	13	2	–	3	5	–	–	2	5	16
uphorbia-type	8	4	30	8	13	10	16	30	16	33	11	12	25	11
arrea	10	26	9	15	18	4	13	23	13	8	14	2	–	–
eguminosae	13	9	17	2	2	10	12	–	5	10	8	–	5	–
yctaginaceae	–	4	–	2	10	10	6	o	5	4	o	6	5	14
cacia	5	–	4	–	5	4	9	–	–	–	3	6	5	–
imosa	–	–	–	–	–	–	–	–	–	–	–	–	–	–
ycium	–	–	–	–	–	–	–	–	–	–	–	–	–	–
nagraceae	–	–	–	–	3	–	–	–	–	–	o	–	–	–
alvaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	3
ercidium	–	–	–	–	3	–	–	–	–	–	–	–	–	–
alix	–	1	–	–	–	–	–	–	–	–	–	–	–	–
ereus-type	–	–	–	–	–	–	3	–	5	–	–	–	–	–
puntia	3	–	–	–	–	–	–	–	–	–	–	–	–	–
osaceae	–	4	–	–	–	–	–	–	–	–	–	–	–	–
nknowns	6	8	4	8	3	10	3	3	3	2	5	4	10	5

o = less than .2%

Table 31 RAW POLLEN PERCENTAGES FOR Az.Z:14:21

Split Pollen Sum

	Level									
Anemophilous Pollen	Surface	1	2	3	4	5	6	7	8	9
Short-spine Compositae	64	49	43	39	40	38	50	59	56	46
Artemisia	-	-	-	1	-	-	-	-	-	-
Cheno-ams	6	24	22	39	22	18	23	5	2	2
Graminae	27	21	32	23	32	44	26	34	41	50
Pinus	2	2	3	-	1	1	-	-	-	1
Quercus	-	1	-	-	-	-	1	-	-	-
Ephedra	.5	1	-	-	-	-	-	-	-	-
Plantago	-	2	-	-	1	-	-	2	1	1
Celtis	.5	-	-	-	-	-	-	-	-	-
Zea mays	-	-	-	-	-	-	-	-	-	-
Zoogamous Pollen										
Long-spine Compositae	70	14	18	16	17	13	21	11	7	8
Liguliflorae	-	-	2	-	-	-	-	-	-	2
Tidestromia	-	5	2	3	-	-	-	-	-	-
Euphorbia-type	5	2	6	41	72	50	41	29	36	35
Larrea	7	32	40	16	-	25	3	7	3	-
Leguminosae	2	30	11	3	-	3	24	7	10	10
Nyctaginaceae	o	-	3	-	6	-	6	25	34	24
Acacia	4	-	3	3	-	-	-	-	-	-
Mimosa	-	-	-	-	6	-	-	-	-	-
Lycium	-	-	2	-	-	-	-	-	-	-
Onagraceae	-	-	-	-	-	-	-	-	-	-
Malvaceae	-	-	2	-	-	-	-	-	-	-
Cercidium	-	-	-	-	-	-	-	4	-	-
Salix	-	-	-	-	-	-	-	-	-	-
Cereus-type	-	-	-	-	-	-	-	-	-	-
Opuntia	2	-	2	3	-	-	-	-	-	-
Rosaceae	1	-	-	-	-	-	-	-	-	-
Unknowns	3	9	11	10	-	9	3	18	8	8

o = less than .2%

topographically on the lower bajada in an apparently transitional Larrea-Franseria association between Arizona Upland and Lower Colorado Valley vegetation subdivisions. The vegetation cover is equally dominated by creosotebush (Larrea divaricata) and bursage (Franseria dumosa, F. deltoidea), with almost bare ground between plants. A few saguaro (Cereus giganteus), paloverde (Cercidium microphyllum) and cholla (Opuntia fulgida) are scattered throughout and become denser on the slopes. Paloverde, mesquite (Prosopis juliflora) and, at Az.Z:14:21, Yucca elata occur along small washes near the sites. The upper bajada and slopes of the nearby hills support a Cercidium-Cereus association (Lowe 1964b: 24), with accompanying Acacia sp., Lycium sp., Sapium biloculare, ocotillo (Fouquieria splendens) and others. The pine and oak pollen, long-distance travelers, were blown in from the surrounding mountains.

The predominant pollen types belong to three families, Graminae, Compositae, and Chenopodiaceae, plus the genus Amaranthus. This is the usual characteristic of pollen diagrams from southern Arizona (Martin 1963; Hevly, Mehringer and Yocum 1965). The three pollen types with the highest frequency of occurrence are anemophilous. They are designated as Cheno-ams (combining the morphologically similar Chenopodiaceae and Amaranthus), Graminae and short-spine Compositae on the diagrams. A distinctive chenopod, the insect-carried Tidestromia, is treated as a separate type. The wind-carried, short-spine Compositae pollen is separated from the zoogamous long-spine types because of differing morphology and function. Together these represent the sub-family Tubiflorae as discrete from the lophate pollen of the subfamily Liguliflorae, which occurs very rarely in the diagrams.

The major source for short-spine composite pollen is no doubt Franseria spp. Artemisia pollen is also of the short-spine Compositae, morphologically distinct enough to have its own place in the diagrams, but rarely occurring. The long-spine types may include brittlebush (Encelia farinosa), Bebbia juncea, Dyssodia spp., Porophyllum gracile, Trixis californica, Stephanomeria spp., and Viguiera spp.

The category Graminae includes the numerous palynologically undifferentiated grasses of the upper bajada and mountain slopes. Aristida ternipes, Bouteloua filiformis, Enneapogon desvauxii, Heteropogon contortus, Muhlenbergia porterii, Trichachne californica, Tridens muticus and T. pulchellus have all been observed in the Ajo Mountain region.

Besides the long-spine Compositae, the most frequent zoogamous pollen types are Larrea, Nyctaginaceae, probably Mirabilis bigelovii and a Euphorbia-type, including perhaps Euphorbia spp., Jatropha sp., and Sapium biloculare. The Cactaceae pollen is divided into two categories: the tricolpate, echinate Cereus-type (including Cereus giganteus, Echinocereus sp., and Mammillaria), and the periporate Opuntia-type (Cylindropuntia sp., including O. fulgida and O. acanthocarpa). The relatively large category of unknown Leguminosae includes Prosopis (and perhaps Olneya) pollen and various nonarboreal genera. The other arboreal legumes, Acacia sp. and Cercidium, with their distinct pollen morphology, have their own categories. Altogether, eighteen families are represented in the pollen diagrams.

Zea mays, the only cultivated plant definitely identified in the samples, was represented by a single pollen grain at 90 cm in the Az.Z: 19:33 spectra.

Deposition and Preservation

The alluvial fan sedimentary environment presents some of the worst conditions for pollen deposition and preservation. The processes are primarily depositional, but, unlike the sediment traps of basins, the chance of disturbance is very high because of slope runoff. Sheet flow and stream channeling deposit, remove, rework and redeposit sediments at different rates and times on different parts of the bajada. Sheet flow especially tends to transport pollen from higher elevations to the lower bajada. This is more critical for the locally concentrated zoogamous pollen then for the widely disseminated anemophilous types. Cut-and-fill structures are less of a problem, since they comprise a minor proportion

of the bajada and are rare on the lower bajada. They also can usually be identified in profile and on the surface. The small arroyo running through Az.Z:14:33 signals caution in the analysis of the upper pollen samples.

The debris-charged sheet flow erodes pollen grains, and the oxidizing nature of the deposits further contributes to their destruction. As expected, the pollen from all three sites is very crumpled, broken and degraded, with thin exines, making identification very difficult and increasing the chance of statistical error in counting. Possible sources of misidentification could be the inclusion of small, degraded Caryophyllaceae grains in the cheno-am category, mistaking crumpled Celtis pollen for grass types if only a single pore is visible and placing long-spine Compositae types having corroded spines with the short-spine Compositae. The rare occurrence of the first two types and the abundance of cheno-ams, grasses and wind-borne Compositae keep the error from becoming significant.

The Modern Pollen Rain

Surface pollen samples were analyzed to relate the present vegetation pattern to recent pollen deposition. The two surface spectra are very similar, displaying a present dominance of short-spine Compositae, followed by higher percentages of Graminae, cheno-ams and long-spine Compositae and lower frequencies of Euphorbia-type and Larrea. The spectra are comparable to the Sonoran Desert scrub pollen rain along the Wassen Peak-Avra Valley transect in the Tucson Mountain area (Hevly, Mehringer, and Yocum 1965: Fig. 12), specifically the lower bajada Larrea-Franseria subdivision. The anomalously high frequency of long-spine Compositae in the Az.Z:14:21 diagram illustrates the difficulty of interpreting zoogamous pollen frequencies due to local dissemination on the ground. A single pinch of surface material could have contained a cluster of long-spine type pollen shed from a nearby annual.

The Tucson Mountain transect and Gu Vo surface pollen indicate, in general, the influence of local vegetation communities on the pollen rain.

Hevly, Mehringer and Yocum (1965) concluded that horizontal changes in pollen frequency are due to edaphic conditions rather than regional climate. Thus, it is important to hold edaphic factors constant for a single pollen profile by sedimentary and geomorphic analysis in order to infer the impact of any possible climatic change.

The fossil pollen spectra compare in composition and frequency to the modern southern Arizona surface samples. Each pollen diagram is discussed separately, since different collecting strategies and time periods are involved.

The Pollen Diagrams

The Az.Z:14:21 and Az.Z:14:33 (Fig. 56a, b) diagrams include a percentage curve of total pottery and cultural lithics found in each level of the excavation unit from which the pollen profiles were taken. This curve indexes human occupation density and activity, a major governing factor of the pollen frequencies. The pollen curves, based on the split pollen sum, were plotted to reduce the constraints of some zoogamous taxa percentages on the anemophilous pollen curves.

The total number of pollen grains varied greatly from sample to sample, probably due to different preservation and sedimentation rates. There was sufficient pollen in all of the samples but one for a 200-grain count on each slide. The sample from Az.Z:14:33 at 140 cm was nearly devoid of pollen. The spectra are grouped into pollen zones in order to clarify the major frequency changes within each site.

Az.Z:14:33

The Az.Z:14:33 diagram is the most complex. It is divided into six zones, dependent mainly on the fluctuation of cheno-ams and short-spine Compositae. These two types complement one another, displaying a major opposing trend from bottom to top. Graminae pollen has no overall increasing or decreasing trends, but has many minor fluctuations. Zones II, III, IV and V record two peaks in the cheno-am curve and opposing decreases in the short-spine Compositae curve.

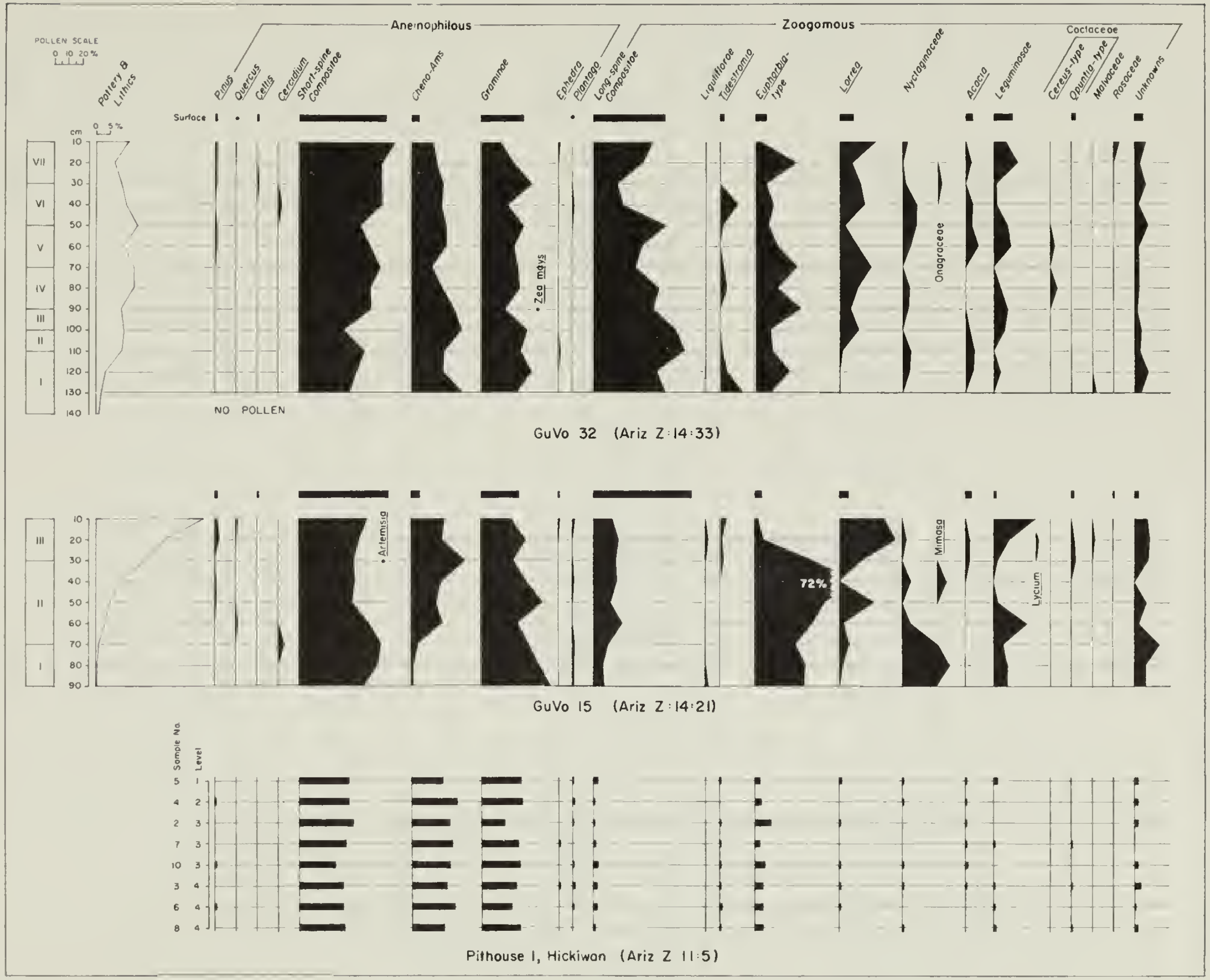

Figure 55. Split pollen sum profile, Arizona Z:14:33 and Arizona Z:14:21.

Much of the grass pollen frequency seems to be controlled by that of the short-spine composites and cheno-ams. This is apparent since the overall course of the grass curves in both Az.Z:14:13 and Az.Z:14:33 diagrams is independent from the cheno-am and composite curves. At present the grass pollen source lies predominately outside the sampling area so is not affected as much by the local conditions governing the cheno-ams and composites. The saw-toothed form of the grass curves is thus more likely to result mainly from the statistical constraints of a proportional diagram.

In the Tucson Mountain transect diagram, the grass pollen component maintains a constant level throughout the Sonoran Desert scrub and operates as a background count. Because of its relative independence from the ecological factors in the immediate vicinity of the sites, grass is probably a more dependable indicator of large-scale environmental changes.

The zoogamous pollen types are more irregular in their frequencies. The long-spine Compositae decrease slightly to a minimum between 20 and 40 cm before recovering to the near-surface percentage (43% and 51%, respectively). Larrea tends to increase, and both the Euphorbia-type and Nyctaginaceae fluctuate about an average.

Az.Z:14:21

The diagram of Az.Z:14:21 has the simplest curve pattern. Among the wind-pollinated types, the short-spine Compositae and cheno-ams have complementary curves. Zone 1 shows an increase in the short-spine Compositae which may or may not be significant; a peak is reached with a percentage similar to the modern surface spectrum. The cheno-ams are similarly comparable. Graminae begins with a high of 50% and drops throughout the zone into the next. In Zone II the short-spine Compositae drop sharply and the cheno-am percentage rises to a peak of 39%. Grass peaks in mid-zone, only to drop again to 23%. Zone III defines a recovery of the short-spine proportion to 43% and a drop in cheno-ams to 24%. Graminae again reaches a smaller peak and drops to its lowest percentage in the diagram, but one similar to that of the surface sample. Overall, grass pollen is constantly decreasing with sharp fluctuations, while the cheno-ams and short-spine

Compositae define a complementary increase and decrease in percentages through the entire pollen profile. Pine increases slightly throughout. At the top of Zone III, all of the anemophilous taxa tend to reach the proportions of the surface spectra.

Among the zoogamous pollen types the long-spine Compositae reveal no significant trend. The Euphorbia-type maintains a high percentage until Zone III, Larrea increases with fluctuations to peaks of 32% and 40% in Zone III, and the Nyctaginaceae decreases to insignificance after an initial high of 24% to 34% in Zone I. Larrea and the Nyctaginaceae in Az.Z:25:21 especially show a large variation in their spectra; this distorts the functionally related short-spine composite, cheno-am and grass curves.

Az.Z:11:5

The Az.Z:11:5 pithouse diagram essentially records a single time period (Classic) showing a relatively stable pollen frequency throughout the spectra. Percentage differences between levels are the expected statistical "bounce" resulting from a number of variables and sampling errors. The proportion of cheno-ams to short-spine composites is equivalent to the culturally densest levels of Az.Z:14:21 and Az.Z:14:33. This accords well with the possible relation of pollen frequencies to human activity.

Interpretations and Conclusions

Two related and unsolved problems remain in interpreting these diagrams: (1) the sedimentation history and (2) the natural vegetation history. The pollen spectra appear to embrace the entire period of human occupation of the sites; however, while artifacts were found at all levels, excavation was limited to wherever cultural remains were recovered. Therefore, there is no control over the differences between sedimentation processes prior to and those during human occupation. A separate pollen record unbiased by human activity reflecting local vegetative history is

also lacking. Without such controls, there is no way to differentiate all the variables to which the vegetation may be responding.

An increase in sedimentation rate during habitation is assumed. This is especially applicable to Az.Z:14:21, which has the shortest occupation period (Sedentary). Excavations revealed an effective alluvial deposition of at least 90 cm during this period but no apparent sedimentary overburden after the site was abandoned. Wind and water erosion after abandonment, however, may have exposed the site, abruptly terminating the presence of more erodable materals. The artifact percentage curve at the surface may thus indicate a lag concentrate of the heavier artifacts due to erosion. This is supported by the pollen curves and is discussed below.

Archeological significance of pollen frequencies may be inferred from the correlation of pollen and artifact percentage curves and the comparison of fossil pollen and modern pollen proportions. The brief time period assures that the trend reversals of pollen frequencies are not climatically induced. Alluvial pollen from noncultural deposits is not sensitive enough to record vegetation response to low amplitude fluctuations of temperature and effective precipitation. So, in cultural deposits, the past impact of people on the vegetation ecosystem and on sedimentary processes surely obscures any possible small-scale climatic effects.

The interaction of short-spine Compositae and cheno-ams gives the soundest data for vegetation changes in a cultural situation. Southwestern pollen transects show that their dominance commonly changes over short distances and may be related to edaphic factors. It is known that members of the Chenopodiaceae grow by preference on disturbed soils and soils with fine-grained texture and high alkaline content (Martin 1963: 49; Hevly, Mehringer and Yocum 1965: 134). Human disturbance most likely provided ideal conditions for the growth of chenopods and *Amaranthus*, especially where floodwater farming was involved. Further, probable clearance of the bursage in the area reduced the density of the short-spine composite pollen source. This inference can clearly be applied to the Az.Z:14:21 diagram where increase in artifact frequency is correlated with an abrupt decrease in short-spine Compositae and an equally abrupt increase in

cheno-ams. The trend toward recovery of the normal Sonoran Desert scrub proportions of these two pollen types in Level 1, however, seems incongruous with the continued high pottery and lithic frequency unless the lag concentrate effect is accounted for. In this case, the heavier artifacts remained in place, while the finer-grained sediments, including pollen, were subject to greater erosion relative to deposition after the site was abandoned, leaving a foreshortened pollen record.

The Az.Z:14:33 diagram does not so clearly support this interpretation; the major composite and cheno-am trends appear to override human influence. Only between 40 and 70 cm, where the artifact density peaks, does the cheno-am and short-spine Compositae pollen definitely reflect human activity. The other reversal in cheno-am and short-spine composite frequency at 100 cm shows only minor agreement with the artifact curve. However, the disturbed, mixed nature of the sediments at this site, especially in the upper levels, makes any explication of cultural-vegetation relationships very tentative.

The long-term course of the grass pollen in both sites may be the consequence of either edaphic or climatic changes, but no definite conclusion can be made without the data necessary to factor the two variables. This applies also to the general course of the cheno-am and short-spine composite pollen curves of Az.Z:14:33.

In conclusion, the pollen diagrams from all of the sites indicate, for the period A.D. 1000 to 1500 and probably later, a relatively stable local vegetation community with a species composition similar to the present Sonoran Desert scrub. Artificial changes were produced around the sites by human occupation and cultivation practices, causing a temporary dominance of chenopods and *Amaranthus*. Any climatic changes during this time were either too small to leave a trace in the pollen rain or cannot be separated from the edaphic and cultural variables.

APPENDIX IV

HUMAN SKELETAL REMAINS FROM Az.Z:11:5

By

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Arizona State Museum

Human skeletal remains of two individuals (Burial 1 and Cremation 1) recovered by the Western Archeological Center near Hickiwan, Arizona, were submitted to the Human Identification Laboratory of the Arizona State Museum for analysis. Results of the examination follow.

BURIAL 1

Sex: Male (?)

Age: 12 years plus or minus 6 months

Race: Mongoloid (American Indian)

Stature: Not determinable

Dentition: A total of 27 adult teeth are present for this individual. Neither the mandibular nor the maxillary third molars are erupted and the left central upper incisor is missing postmortem. No carious activitiy is observed. Hypoplastic rings (enamel hypoplasia) occur on the right maxillary central incisor, lateral incisor, canine and first molar, on the left maxillary lateral incisor, canine and first molar and on the right mandibular canine, first molar, and second molar. Protostyloid pits are found on both mandibular first and second molars.

Pathologies/Anomalies

No bony pathologies or anomalies were observed, so the specific agent responsible for this individual's death cannot be determined from the remains.

General Description

The skeletal remains of this youth are fragmentary, especially postcranially, and show signs of rodent gnaw-marks. The race is determined by shovel-shaped incisors, by a blunt nasal sill and by archeological context.

Although there is no reliable method for skeletally sexing prepubertal individuals, this individual shows some development of male cranial features such as a robust occipital, a hint of a supramastoid crest (on the temporal), as well as a square-shaped chin. Identification of age is based on dental maturation; there are incompletely formed root apices for the premolars and maxillary second molars. In addition, the canines have completely erupted.

Enamel hypoplasia can result from a variety of dietary, hormonal, and physiological disturbances (for example, D avitaminosis, hyperparathyroidism, and exanthematous fever, respectively) and, in general, from hazardous living conditions (Brothwell 1963).

CREMATION 1

Sex: Male

Age: 30-40 years

Race: Mongoloid (American Indian)

Stature: Not determinable

Dentition: All of the observable cremated dental remains are still located in the maxillae and mandible. The following seven teeth retained sufficient portions of their crowns on which observations for dental pathologies could be made, but none were observed: the upper right first and second premolars, the lower right canine, the upper left canine, the upper left first and second premolars and the lower left central incisor.

Only the maxillary left first molar and the mandibular left canine and third molar exhibit carious activity, the maxillary tooth having a cervical caries distal and the two mandibular teeth showing occlusal caries. Apical abscesses of the mandibular left canine and first premolar are present and result from the carious condition of the former.

The crowns of the maxillary right central incisor and canine have broken off postmortem, leaving the roots in the alveoli. Only the lingual root of the upper right first molar was in the alveolus antemortem and shows signs of wear. The lower right first premolar, the lower left second premolar and lower left first and second molars were lost antemortem because their alveoli display bony resorption.

The upper right lateral incisor and second premolar, the lower right central incisor, lateral incisor and second premolar, the upper left central incisor, lateral incisor and second molar and the lower left lateral incisor were all lost postmortem. None of the sockets for these teeth show evidence of pathology.

Pathology

The external cortex of the frontal bone is quite thick and dense. The etiology of this abnormal condition cannot be determined.

General Description

The total weight of this "green bone" cremation is 737 grams. The cranial weight constitutes most of the cremated bony remains (511 grams). (A complete adult cremation approximates 2000 grams, so that less than half of the total skeleton is represented in Cremation 1.) Perhaps this individual was not adequately recovered from the crematorium for subsequent burial. Also, the postcranial remains may have been poorly preserved.

Interestingly, the remains have been differently burned. Some bones show no signs of firing at all (e.g., much of the cranial vault and various rib fragments), while several bones such as the mandible and some long bones are well calcined. The face and sides of the head are quite charred, yet the top of the head was not altered by heat whatsoever.

Several explanations may account for this:

1. This adult may have been inadvertently cremated, i.e., cremation may not have been intentional, but accidental.
2. This was an intentional cremation, but was inefficiently instrumented.

3. Part of the body (leg, the top of the head and the ribs) may have been protected by articles of clothing or by soil and were not exposed to the fire.

The sex is determined from blunt supraorbital borders, a robust occipital and a well-defined supramastoid crest. Such features are more indicative of males. The age identification is based on third degree (and on some teeth, fourth degree) dental attrition (Stewart 1952). Heavy dental wear usually results from the use of the mano and metate which introduces grit into the processed foodstuffs. The racial identification is based on the archeological context and on the practice of cremation for the disposal of the human remains.

The crania represented in both Cremation 1 and Burial 1 are occipitally deformed, slight in the former and well-defined in the latter. This type of deformation is usually produced from the use of cradleboards.

A complete inventory of all osseous identifications, osteoeotrics and observed discontinuous traits is on file in the Human Identification Laboratory of the Arizona State Museum.

APPENDIX V

RADIOCARBON DATING OF THE QUIJOTOA VALLEY SAMPLES

By

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Seven charcoal samples from the Quijotoa Valley sites were dated for the Western Archeological Center of the National Park Service by the Laboratory of Isotope Geochemistry, University of Arizona. The analysis was carried out by myself, assisted by Mr. Robert Donnelly, under the direction of Dr. Paul E. Damon and Dr. Austin Long. The results of the determination are as follows:

Table 32 RADIOCARBON DATING ANALYSIS

U of A Sample #	WAC Nos.	Site Numbers	Stable Carbon Isotope Values	Del - ^{13}C Corrected Dates B.P.	Dendrochronologically* Corrected Dates B.P.
A-1627	2	Az.Z:11:5	-22.04	950 ± 50	930 ± 70
A-1628	3	Az.Z:11:5	-23.20	890 ± 50	870 ± 70
A-1629	4	Az.Z:14:30	-22.52	920 ± 60	900 ± 70
A-1630	5	Son.C:2:20	-22.49	330 ± 70	370 ± 90
A-1631	6	Son.C:2:20	-22.90	290 ± 60	340 ± 80
A-1632	7	Son.C:2:22	-23.19	140 ± 70	210 ± 80
A-1633	8	Son.C:2:22	-23.75	290 ± 70	340 ± 90

NOTE: B.P. = years before 1950 A.D.; $T_{1/2}$ = 5568; error is one sigma; Stable Carbon Isotope values (Del - ^{13}C, $^{o}/oo$) referenced to PDB.

* See Damon and others 1972.

Figure 56. Radiocarbon sample A-1629 from a hearth at Arizona Z:14:30.

From dendrochronologically corrected dates, it is clear that the three older dates are statistically equivalent, as are the four younger ones. In each group, the dates overlap at the one sigma error level.

DATING METHODS

Fifteen to twenty grams of each sample were first mechanically pretreated by removing all visible traces of dirt and rootlets. Next, the samples were given a standard chemical treatment wherein each was heated in 1N HCl (to remove mobile carbonates), then in 2% NaOH (to remove mobile organic acids) and, finally, each was washed in 1N HCl. Water baths followed each chemical solution. About 6 grams of the treated charcoal were combusted per sample, and the purified carbon dioxide from each was then placed into either a 2 liter or one-half liter gas proportional counter where its carbon-14 activity was determined by anti-coincidence counting. Each datum point is the average of at least three 1,000-minute counting periods, all in statistical agreement. An on-line teletype and INTERCOM

terminal to a CDC-6400 computer provided automatic standard and background referencing and age computations for each sample.

CORRECTIONS

Stable carbon isotope measurements (Del - ^{13}C) were made on each gas sample in order to correct for fractionation differences between it and the standard reference gas. On the average, this resulted in an age increase of about 30 years. Next, to correct for variations in the radiocarbon content of the atmosphere over past centuries, each date was converted to solar calendrical years by using dendrochronological calibration tables (Damon and others 1972). This correction resulted in slightly younger ages for the three older samples and in slightly older ages (about 10% older) for the four younger ones. The calibration error (tree rings vs. radiocarbon dates) is responsible for the increased statistical error of the final corrected dates.

Finally, a consideration of sample contamination revealed only one area of minor concern. It is impossible to insure 100% removal of the microscopic-sized rootlets from charcoal fragments during pre-treatment. The fraction remaining, however, must be quite small. I believe a _very_ conservative estimate to be not more than 10 mg per gram of carbon (or 1% modern) and, even at this extreme, the error around 900 B.P. would make the age only about ten years too young.

APPENDIX VI

RADIOCARBON AGE DETERMINATION

By

Harold W. Krueger

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In conjunction with the laboratory analyses of the Quijotoa Valley Project collections, two radiocarbon age determinations were completed. As pretreatment, selected charcoal fragments were cleaned of visible impurities. Then, prior to combustion and analysis, they were digested in hot hydrochloric acid (HCl) and hot dilute sodium hydroxide (NaOH) to remove chemical contaminants.

Dating is based upon the Libby Half Life (5,570 years) for carbon-14. Error is plus or minus 1 sigma as judged by the analytic data alone. The modern standard is 95% of the activity of (National Bureau of Standard) Oxalic Acid. The age is referenced to A.D. 1950.

The age of charcoal sample 1 from Hearth #1 at Az.Z:11:5 is 752 plus or minus 123 radiocarbon years. The date of this sample is near the end of the age B.P. range that was suggested before the analysis (A.D. 1100 to 1200). The wood charcoal sample 2, from a roasting pit at Son.C:2:20, dates no more than 200 radiocarbon years B.P. Sample 2 actually counted a rate equivalent to 121 plus or minus 123 carbon-14 years B.P. and thus can be considered essentially modern.

APPENDIX VII

ARCHEOMAGNETIC SAMPLES

By

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and

Robert L. DuBois
Earth Science Observatory
University of Oklahoma

Fourteen archeomagnetic samples were submitted to the Earth Science Observatory at the University of Oklahoma. All samples were collected from the burned rim of the roasting pit at Son.C:2:20 by William Doelle, Department of Anthropology at the University of Arizona, and Douglas Brown.

The considerable dispersion of results among samples indicated no constant archeomagnetic direction useful for dating. Therefore, results obtained from all tests were inconclusive. It is likely that the samples were either not fired well enough or had been contaminated in some manner since their original firing.

APPENDIX VIII

PETROGRAPHIC ANALYSIS

By

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and

Marc B. Severson
Western Archeological Center

In conjunction with the ceramic analysis, Jay Severa of Western Petrographic, Incorporated, analyzed thin sections of 14 sherds. Initial comparisons by Severson after visual inspection were augmented by the laboratory analysis of Severa. Considering the nature of the samples, the amount of data generated by the petrographic study is enormous. The original report with detailed data is on file at the Western Archeological Center. This report summarizes material from Severa's analysis according to Severson's type similarities.

GROUP I: I-274, H-142. Tanque Verde Red-on-brown.

This group is composed of relatively high matrix content, fine-grained, yellow-brown sherds with abundant quartz and feldspar. Of the rock fragments, granite and caliche are the most prominent; volcanic and metamorphic rocks are scarce. Key components are granite, caliche, quartz and feldspar.

The comparison of the two Tanque Verde Red-on-brown sherds, one of which came from Az.Z:14:33 and the other from Az.Z:11:5, shows considerable similarity. Of particular interest are the identical percentages of parent material (matrix), the predominance of quartz, the similar grain size and the additional presence of abundant plagioclase, potassium feldspars, granite and caliche in each sample.

GROUP II: I-256, I-347, H-340. Gila Red, Sells Plain micaceous and Gila Plain.

Despite variations in color, matrix content and lithology, these four samples all seem to have a common origin. They are mostly dark-colored and have a coarse grain size. Plutonic igneous fragments, however, predominate, except where they have been apparently broken down (crushed). Quartz and feldspar are always present, and mica—particularly muscovite—is abundant. The samples may differ according to both how (manually or naturally) and when the mineral fragments were crushed to form the material for fabrication of the artifacts. H-340, which is composed mostly of quartzite and lacks plagioclase, may not belong to this group. However, it does contain abundant mica flakes. Key components are granite, quartz diorite, caliche, muscovite, quartz, plagioclase and potassium feldspar.

In Group II an effort was made to draw comparisons between three different micaceous wares. Two sherds of Gila Red, differing in surface treatment, both from Az.Z:14:33, compare fairly closely but obviously represent different clay sources. The presence of both muscovite and biotite mica in one sample, as opposed to just muscovite in the other, is interesting as it has been contended that the Hohokam selected only muscovite mica to add to their ceramics.

The apparent differences between the Gila Red samples and the Gila Plain are manifested by a coarse grain size in the latter, as opposed to medium grain size in the redwares, the absence of plagioclase in the Gila Plain sample and the dominance of metamorphic quartz as well as feldspar in the redwares.

GROUP III: G-136, I-318, I-278. Sells Plain, slate.

This group is sharply differentiated from all the others by the predominant, altered andesite rock fragments. The samples are brown, relatively coarse-grained and low in matrix. Altered biotite, the most prominent mineral constituent, as well as quartz, is conspicuous in all three samples. Neither volcanic, except for andesite, or sedimentary rocks are abundant, but various metamorphic rocks such as slate and schist

are well represented. Key components are altered andesite, slate and altered biotite.

The three samples of Sells Plain with slate inclusions compare very closely. Two were from Az.Z:14:33 and one was from Az.Z:14:30; all probably represent the same clay source.

GROUP IV: L-33, L-45. Colorado Buff.

L-33 and L-45 are similar except for the type and amount of plagioclase present. Both have a moderate percentage of matrix, are fine-grained and reddish-brown. Quartz and plagioclase are the most abundant constituents. Caliche is the most characteristic of sedimentary rock fragments. These two samples are somewhat undistinguished in mineralogy, and the correlation between them is not as strong as that among other groups. However, their overall similarities make it probable that they are related. Key components are caliche, quartz diorite, andesite/dacite, quartz and plagioclase.

The two sherds of Colorado Buff are composed of similar constituents and are the only fine-grained samples. Their matrix percentage is almost identical. They may represent intrusive wares from the Colorado River whose clays have a similar parent rock but are sedimentary rather than igneous in origin. Probably two different clay sources are involved here also.

GROUP V: I-381, H-461. Sells Plain and Sells Plain micaceous.

The two samples apparently are not related. I-381 is derived from volcanic rocks (andesite and basalt), while H-461 is composed of detritus from a granitic area.

The micaceous Sells Plain sample compares fairly well, but is dominated by vein quartz and, like the Gila Plain, is coarse-grained. This substantiates the relationship between type of clay selected and care of preparation mentioned earlier in the ceramic report. Because igneous clay was used for all these samples, the Petrography Summary (Severa 1976) mentions their probable common origin.

The apparent difference between the Sells Plain and micaceous Sells Plain sherds is simple. The former is volcanic based, and the latter is granitic. The same is true of the two samples compared in Group VI, Sells Red and Sells Plain. These may, however, distinguish the pottery made from clays near a permanent village like Jackrabbit Ruin from those wares made at the semi-permanent sites of the Quijotoa Valley, or they may represent regional differences.

GROUP VI: I-331, I-382. Sells Red and Sells Plain.

These two samples are apparently not related. I-331 is a high matrix, granitic type, while I-381 is low in matrix percentage and derived from volcanic rocks. I-331 is much more similar to H-461, which was also suggested as a correlative of I-381.

GROUP VII: GV-32c. Sells Plain, stained andesite.

No comparison was requested for this sample. It is too thoroughly crushed for many rock fragments to be recognized but appears to belong to the granitic-area types such as Groups I, II or IV. I-381 is most similar to GV-32c in appearance, and these two samples may belong in Group VIII.

GROUP VIII: I-381, GV-32c. Sells Plain and Sells Plain, stained andesite.

These two specimens seem to be similar to each other, even though they were not among those to have been tested. They are characterized by dark color, coarse to medium size grain, presence of andesite, granite and quartz diorite and a low percentage of potassium feldspar. Key components are granite, quartz diorite, andesite, quartz, plagioclase and epidote.

The final comparison is illustrated in Tables 34 and 35 which summarize the observed correlations and their quality. The association of the Sells Red with the Yuman wares was also derived through analysis and reflects similar constituents, color and matrix percentage.

In conclusion, the plainwares generally are coarse-grained, as compared with the medium grain redwares and decorated wares, and the fine grain Yuman wares, which are considered sedimentary. The petrography of

the samples reflects the two most common sources of southern Arizona clays (granitic and volcanic rocks). Their grain sizes and matrix percentages generally point up the selectivity between coarse-grained utility wares and finer, more valued pieces.

Table 33 SUMMARY OF PETROGRAPHY

		Felsic			Mafic				Secondary						Iron Oxides			Plutonic	
		Quartz	Plagioclase	Feldspar	Hornblende	Biotite	Muscovite	Sphene	Calcite	Chalcedony	Choorite	Clay	Epidote	Vein Quartz	Hematite	Limonite	Magnetite	Granite	Quartz diorite
I.	I-274	P	A	A		T		T				T	T	A				A	
	H-142	P	A	A	T							T			T			A	
II.	I-256	P	A	A			A						T	T			T		
	H-461	A	A	A		A	T						A	P			T	A	A
	I-347	A	A	A		A	A						A	A			T	A	P
	H-340	P		T		?	A							A			T	A	A
III.	G-136	A	T		A	?	A						T	T		A			
	I-318	A	T	A		A			T		T			A			T	T	
	I-278	A	A	T	T	P							T	A					
IV.	L-33	A	P	T		T							T	A			A	T	A
	L-45	P	A	A			T			T				A			T	T	A
V.	I-381	A	P	T									T		A	T			
	H-461	A	A	A			T						A	P				A	A
VI.	I-331	A	P	A									T				A	A	A
	I-381	A	P	T									T		A	T			
VII.	GV-32	P	A	T	T								T				A	T	T

Legend:

T = Trace
A = Abundant
P = Predominant

Table 33 (continued) SUMMARY OF PETROGRAPHY

		Volcanic				Alt. Volc.	Sedimentary			Metamorphic				% Matrix	Grain Size	Color
		Rhyolite	Dacite	Andesite	Basalt		Sandstone	Limestone	Caliche	Hornfels	Quartz	Schist	Gneiss			
I.	I-274	T				T			A					55	Medium	Grey-yellow
	H-142		A				T		A		T	T		55	Medium	Yellow
II.	I-256	T			T	T		T	T			T		40	Medium	Yellow
	H-461								T		T	A		47	Coarse	Green-Grey
	I-347				T							A		51	Medium	Brown
	H-340	T	T								P			43	Coarse	Grey-black
III.	G-136			P								A		35	Med-coarse	Brown
	I-318		T	P		A				A	T	A		43	Coarse	Red-brown
	I-278		T	P								A	A	44	Coarse	Brown
IV.	L-33			A		T			T			A*		51	Fine	Red-brown
	L-45	T	A		A	A			A					50	Fine	Brown
V.	I-381			A	A									45	Coarse	Brown-black
	H-461								T		T	A		47	Coarse	Green-grey
VI.	I-331						T	A						54	Medium	Red-brown
	I-381			A	A									45	Coarse	Brown-Black
VII.	GV-32			T								T		58	Medium	Grey-brown

* Slate

Table 34 SUMMARY OF OBSERVED CORRELATIONS

GROUP	Number	Key Components
I	I-274, H-142	granite, caliche
II	I-256, H-461, I-347, H-340	granite, quartz diorite
III	G-136, I-318, I-278	andesite, schist, slate
IV	L-33, L-45	quartz diorite, dacite
V	No correlation	
VI	No correlation	
VII	GV-32C	
VIII	GV-32C, I-381	granite, quartz diorite, andesite

Note: I-331 probably belongs in Group IV.

Table 35 QUALITY OF THE ABOVE COMPARISONS

GROUP	Number	Quality	Ceramic types
GROUP I	I-274	Good	Tanque Verde Red-on-brown
	H-142	Good	Tanque Verde Red-on-brown
GROUP II	I-256	Good	Gila Red
	H-461	Good	Sells Plain micaceous
	I-347	Good	Gila Red
	H-340	Fair/good	Gila Plain
GROUP III	G-136	Excellent	Sells Plain - slate
	I-318	Excellent	Sells Plain - slate
	I-278	Excellent	Sells Plain - slate
GROUP IV	L-33	Fair/good	Colorado Buff
	L-45	Fair/good	Colorado Buff
	I-331	Fair	Sells Red
GROUP V	I-381	Poor	Sells Plain
	H-461	Poor	Sells Plain micaceous
GROUP VI	I-331	Poor	Sells Red
	I-381	Poor	Sells Plain
GROUP VII	GV-32C		Sells Plain - andesite
GROUP VIII	GV-32C	Good	Sells Plain - andesite
	I-381	Good	Sells Plain

APPENDIX IX

SHERD REFIRING EXPERIMENTS

by

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To compare various ceramic types and estimate their original firing temperature, I refired several samples in a small kiln in the laboratory of the Western Archeological Center. Twelve samples were tested in temperatures ranging from 450° C to 850° C. The types tested include one sherd each of Gila Plain, Colorado Brown, Papago Red-on-brown, Papago, Sells and Gila Red and two sherds each of Colorado Buff, Sells Plain and Tanque Verde Red-on-brown. The most significant data is noted in Table 36. The Munsell Soil Color Chart (1954) was used to describe the changes during refiring.

The Gila Plain sherd from Az.Z:2:11.5 was a typical specimen, approximately 0.5 cm thick, mottled grey to brown in color, with considerable muscovite mica in the paste. The sherd exterior had a slight polish caused by a scraping tool. There were also exterior fireclouds and evidence that mica expansion caused surface flaking and pitting. The interior had characteristic anvil marks, but less pitting was noted, indicating that firing was hotter on the exterior of the vessel. The only change at 500° C was a slight color lightening, indicating that some carbon was combusted (Table 36). At 850° C, a radical color change occurred. Consequently, it is assumed that the original firing temperature for the Gila Plain Sherd at Az.Z:2:11:5 was around 500° C, which is fairly low (Shepard 1956).

The two Colorado Buff sherds possessed a typical exterior scum that was darker than the interior surface or core. Refiring tests surprisingly indicated that they, too, had been fired at a fairly low temperature, undoubtedly less than 700° C and probably about 600° C. The lack of drastic color change of the Colorado Brownware seems to corroborate this

Table 36 SHERD REFIRINGS

TYPE	TEMP. °C	SURFACES* Before	After	w/carbon	CORE Before	After
Gila Plain	500	10 YR6/2	10 YR6/4			
	700	10 YR6/2	7.5YR7/4			
	850	10 YR6/2	5 YR6/6		10 YR6/2	2.5YR6/8
Colorado Buff #1	450	!Int. 5 YR6/4		5 YR6/6		
		!Ext.10 YR6/2		5 YR4/1		
	650	Int. 5 YR6/4	2.5YR6/6			
		Ext.10 YR6/2	7.5YR7/4			
Colorado Buff #2	500	Int.10 YR6/3	Same			
		Ext.10 YR5/1	10 YR5/2			
	600	Int.10 YR6/3	5 YR6/6			
		Ext.10 YR5/1	10 YR5/3			
	700	Ext.10 YR5/1	5 YR7/6			
	850	Ext.10 YR5/1	2.5YR5/6			
Colorado Brown	600	Int. 5 YR6/6	5 YR5/4			
		Ext. 5 YR5/4	Same			
Sells Plain #1	450	Int.7.5YR7/4		7.5YR3/0		
		Ext.5 YR7/4		Same		
	550	Int.7.5YR7/4		Same		
		Ext.5 YR7/4		5 YR7/6		
Sells Plain #2	700	Int.10 YR2/1	5 YR7/4			
		Ext.10 YR5/2	5 YR7/4			
	850	Ext.10 YR5/2	2.5YR5/8		10 YR5/2	2.5YR6/8
Papago Red	500	Slip 10YR5/6	2.5YR4/4			
	850	Slip 10YR5/6	2.5YR5/6		10 YR2/1	2.5YR5/8
Tanque Verde #1 Red-on-brown	850	Paste 5YR7/6	2.5YR6/6			
		Scum 10YR5/2	2.5YR6/6			
Tanque Verde #2 Red-on-brown	850	Int.10 YR6/1	2.5YR6/6		10 YR4/1	2.5YR5/8
		Ext.10 YR6/1	5 YR7/6			
Papago Red-on-brown	850	Int.5 YR6/1	2.5YR6/8			
		Ext.2.5YR8/2	5 YR6/8			
Sells Red	850	Int.10 YR5/6	2.5YR5/6		7.5YR5/4	2.5YR5/8
		Ext.10 YR5/6	2.5YR5/6			
Gila Red	850	Int.2.5YR5/8	5 YR6/8		2.5YR5/8	5 YR6/8

!Int. = interior, Ext. = Exterior
* 1954 Munsell Soil Color Chart.

temperature estimate, assuming, of course, that the two different clays were fired in the same way.

The two Sells Plain sherds were characteristically thicker (7 mm) than the Gila Plain (5 mm) sherd tested. A temperature of 700° C was sufficient to remove the carbon on the sherds but did not pinpoint the firing temperature. Their original smudging could have been accomplished by secondary firing (Hawley 1930a). Third firings of the "clean" sherds with carbonaceous material (Palo Verde), easily reimplanted the smudging at 450° C and again removed it at 550° C.

The Papago Red sherd was observed for, first, the approximate firing temperature of the slip and second, the change in the dark core. It was startling to note that the slip changed color at only 500° C, indicating its firing must have been at a lower temperature and implying a possible secondary firing at a higher temperature to set the red-colored slip. However, the problem with this theory is that the clay particles of the slip form a better bond with the body when fired with it (Shepard 1956). Consequently, the tenacious slip of Papago Red should have been formed because of simultaneously altering clay particles of the slip and paste. The Papago Red vessel from which this sherd comes, therefore, was fired at a temperature lower than 500° C. This offers a possible explanation for the peculiar, eroded nature of the slip on early Redwares (like Rincon Red) (Kelly n.d.): perhaps the slip was applied after the initial firing and then the vessel was refired.

Both the core and slip colors were almost identical for Sells Plain, Tanque Verde Red-on-brown and Sells and Gila Red when fired at 850° C. This points out the similarities of clay employed. The similar color of the Colorado Buff sherd fired to 850° C shows that, although this is sedimentary clay, the beds may have formed secondarily from the igneous clays, so the basic components are quite similar.

The remainder of the sherds (two Tanque Verde and one each of Papago Red-on-brown, Sells and Gila Red) were actually refired at two temperatures, 700° C and 850° C. However, only the second of these temperatures is noted in the table as the changes at 700° C were miminal for each of

these samples. The only alteration in each case was a slight lightening of the clay brought about by the burning out of carbon particles trapped originally in the clay interstices (Hawley 1930b). At 850° C the similarities between these five types returned, indicating the similar nature of the clay constituents.

In conclusion, the sherd refiring tests indicate that generally the clay compositions of the various ceramic types in our sample changed radically at temperatures around 850° C. It was noted that all the sherds refired at this temperature became more friable and crumbling, suggesting that even if this temperature could have been approached, it would have rendered the vessels useless.

In addition, the color changes at 700° C indicate that most of the wares were fired below that temperature. Because of the slip color change noted at 450° C in Papago Red, this temperature can probably be suggested as a lower limit of the range.

APPENDIX X

DENSITY ANALYSIS

by

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In order to adequately discuss the significance of the weights of each sherd type, differences due to differing densities of individual clays were looked for.

The process followed was to take various samples of each type, note the weight and place the sherds in a graduated column filled to a specific level with water. The volume of water displaced was recorded and then the density calculated according to the formula density equals weight divided by volume (D = W/V).

Forty-five samples, ranging from 12 to 1,332 grams, were tested. Thirty of these were Sand Tempered Sells Plain to give a weight range as well as average density for a large sample.

While results ranged between 1.5 and 3.2 (Table 37), there was considerable clustering around 2.1 density. The probable reason for the lack of great variation is the nature of clay. It is assumed that because clay requires a certain particle size to form, different clusters of these particles will have a similar density due to their size consistency. As a consequence of this experiment, no adjustment was made on our weights as originally recorded for each collection.

Table 37 DENSITY ANALYSIS

Type(number)	Weight(g)	Amount of water displaced (ml)	Density
Sells Plain (30)	823	381	2.16
" "	664	316	2.10
" "	817	375	2.18
" "	375	193	1.94
" "	606	350	1.73
" "	642	302	2.13
" "	440	208	2.12
" "	213	100	2.13
" "	478	150	3.18
" "	247	140	1.76
" "	456	207	2.20
" "	655	309	2.12
" "	705	328	2.15
" "	1,273	598	2.13
" "	121	55	2.20
" "	901	427	2.11
" "	80	38	2.11
" "	237	103	2.30
" "	54	25	2.16
" "	1,281	578	2.22
" "	207	94	2.20
" "	248	110	2.25
" "	405	267	1.52
" "	147	65	2.26
" "	483	189	2.55
" "	55	25	2.20
" "	613	271	2.26
" "	113	48	2.35
" "	264	139	1.90
" "	101	45	2.24
Basalt	344	170	2.02
"	87	34	2.56
"	227	104	2.18
Schist	224	104	2.15
"	12	5	2.40
Slate	138	65	2.12
"	89	42	2.12
Gila Plain	194	90	2.16
Papago Red	1,332	638	2.09
Tanque Verde	551	262	2.10
Sells Red	931	422	2.21
Rhyolite	55	27	2.03
Scum	109	73	1.50
Colorado Buff	790	375	2.10
Gila-Salt Buff	200	93	2.15

APPENDIX XI

STATISTICAL ANALYSIS

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A major focus of the archeological data analysis is comparing the various units which were excavated or surface collected for nonrandom distributions of materials, artifacts or features throughout sites or among sites. Mathematical techniques used to make these comparisons require that all material collected in grid squares should be of the same area and in arbitrary or natural units of the same depth. The Papago Project used consistent field techniques throughout the P.I.R. 1 field activities. Therefore, comparable analytic units were present for all sites. At Huihikiwani (Az.Z:11:5) the English system was used to excavate five foot square units, either three or six inches deep. This site was analyzed separately. All other sites were gridded and excavated in metric units of equal size.

Having fulfilled the prerequisite of comparability of data, we investigated artifact categories by observing attributes and describing variation rather than by immediately typing the classes of material. This does not mean that ceramics or lithics were not typed but that "type" was just one of several descriptive categories. Artifacts were analyzed to determine similarities and differences among and within sites. We hoped to identify patterns of manufacture, style and use. The data was organized by recording attributed observations and then mathematically checking the frequency and significance of their occurrence.

Our research was facilitated by using the computer programs of the Statistical Package for the Social Sciences (SPSS) (Nie and others 1975).

Procedures for using the SPSS programs involved several steps. First, taking an artifact class like chipped stone, we asked specific questions about use and manufacture. Second, we selected attributes which we felt would aid in answering these and other questions. Variables recorded provided information on material, manufacture techniques, style, mistakes, size and shape. Each variable had one or more possible character status; for example, the variable material had nine values (states), of which only one (such as rhyolite) could be present.

The information we recorded was transferred to IBM cards as a permanent record. The Research Support Section of the University of Arizona Computer Center, directed by Larry Manire, provided facilities and access to the CDC 6400 computer. The subprograms of SPSS most frequently employed were PEARSON CORR, FREQUENCIES, and CROSSTABS. The product of analysis (cards, printout) is stored at the Library of the Western Archeological Center. Each descriptive system should be developed to answer the research questions of an individual project. We include our coding system to clarify the artifact discussions.

Table 38 COMPUTER CODE **TOOL - CODING**

Condition

01 - Whole
02 - Partial

Category

01 - Flake
02 - Core
03 - Worked stone
04 - Ground Stone
05 - Utilized stone

Reduction

00 - None
01 - Unifacial
02 - Bifacial

Retouch

00 - None
01 - Unifacial
02 - Bifacial
03 - Both

Cortex (%)

00 - None
01 - Less than 10
02 - 10-50
03 - Greater than 50, less than 100
04 - Total

Surface Alteration

00 - None
01 - Varnish
02 - Patina
03 - Ground stain
04 - Oxidation
05 - Black deposit
06 - Caliche
07 - Burnt
08 to 25 - Combinations of above

Terminus

01 - Step
02 - Hinge
03 - Feather
04,05 - Combinations of above

Platform

00 - None
01 - Cortical
02 - Planar
03 - Unifacet
04 - Multifacet
05 - Reworked
06 to 09 - Combinations of above

Direction of Flaking

00 - No flaking
01 - Undirectional
02 - Bidirectional
03 - Multidirectional

Material

01 - Quartz and Quarzite
02 - Cryptocrystalline silicate
03 - Silicious Mudstone
04 - Basalt
05 - Andesite, fine
06 - Rhyolite, fine
07 - Andesite, porphyry
08 - Other (obsidian)
09 - Rhyolite, porphyry

Flake Type

01 - Nodular core
02 - Flake core
03 - Exhausted core
04 - Cortex flake
05 - Cortex removal flake
06 - Primary flake
07 - Secondary flake
08 - Secondary cortex removal flake
09 - Sidestruck flake
10 - Bifacial thinning flake
11 - Blade
12 - Shatter

Wear

00 - None
01 - Nibbling
02 - Crushing
03 - Oblique

(Continued)

Table 38 COMPUTER CODE TOOL - CODING (continued)

Wear (Continued)

04 - One facet
05 - Two facet
06 - Multifacet
07 - Polish
08 to 11 - Combinations of above

Location of Retouch

A. 00 - None
01 - Inner
02 - Outer
03 - Both

B. 00 - None
01 - Lateral left
02 - Lateral right
03 - Lateral both
04 - Transverse
05 - Platform
06 - Terminus
07 - Planar
08 to 26 - Combinations of above

Location of Use

Same as retouch

Edge

01 - Concave
02 - Convex
03 - Straight
04 to 07 - Combinations of above

Length, Width, Chord (cm)

00 - less than 1
01 - 1.0 to 1.9
02 - 2.0 to 2.9
03 - 3.0 to 3.9
etc.

Thickness (cm)

00 - less than 0.5
01 - 0.5 to 0.9
02 - 1.0 to 1.4
03 - 1.5 to 1.9
etc.

Angle (degrees)

00 - less than 10
01 - 10 to 19
02 - 20 to 29
03 - 30 to 39
etc.

Table 39 COMPUTER CODE SHELL - CODING

Genus	Shell Portion	Artifact
01 - Glycymeris	01 - Valve	01 - Fragment - includes broken & vessels
02 - Laevicardium	02 - Margin	02 - Bracelet
03 - Cardium, Americardium	03 - Hinge	03 - Tinkler
04 - Gastropod (marine)	04 - Umbo	04 - Rings
05 - Gastropod (fresh water)	05 - Spire	05 - Whole valve & blank
06 - Ostria	06 - Valve/margin	06 - Bead, pendants, spool
07 - Olivella	07 - Valve/hinge	07 - Column
08 - Olive	08 - Umbo/hinge	08 - Ground, worked; ring, pendant or bracelet blank
09 - Conus	09 - Outer surface	09 - Scraper
10 - Pecten includes Aegipecton & Leptopecten	10 - Shatter	10 - Gouge
11 - Clam - Chione, Pitar, Dosinia	11 - Whole - includes whole valve	
12 - Turitella	12 - Hinge/margin	
13 - Unknown	13 - Umbo/margin	
14 - Spondylus	14 - Valve/margin/umbo	
	15 - Valve/umbo	
	16 - Column	

Table 40 COMPUTER CODE BONE - CODING

Element	Type	Modification
01 - Skull	01 - Fish	01 - Unmodified
02 - Mandible	02 - Lizard	02 - Charred, burned
03 - Atlas	03 - Turtle	03 - Calcined
04 - Axis	04 - Snake	
05 - Cervical vertebrae	05 - Frog, Toad	
06 - Other vertebrae	06 - Bird	
07 - Sacrum	07 - Rabbit	
08 - Pelvis	08 - Cervid	
09 - Scapula	09 - Rodent	
10 - Humerus	10 - Carnivore	
11 - Radius	11 - Mammal, small and medium	
12 - Ulna	12 - Mammal, large	
13 - Carpals	13 - Unknown	
14 - Femur	14 - Amphibian	
15 - Patella		
16 - Tibia		
17 - Astragalus		
18 - Calcaneum		
19 - Metatarsal		
20 - Tarsals		
21 - Phalanges		
22 - Rib		
23 - Long bone splinters & scrap		
24 - Scrap		
25 - Carapace & plastron		
26 - Teeth		

Table 41 COMPUTER CODE CORE - CODING

Condition

01 - Whole
02 - Partial

Category

01 - Flake
02 - Nodule
03 - Exhausted

Material

01 - Quartz - quarzite
02 - Crypto-crystalline silicate
03 - Silicious mudstone
04 - Basalt
05 - Andesite
06 - Rhyolite
07 - Andesite porphyry
08 - Rhyolite porphyry
09 - Other

Platform

01 - Cortical
02 - Planar
03 - Unifaceted
04 - Diedral
05 - Multifaceted
06 - Ground

Direction of Flaking

01 - Unidirectional
02 - Bidirectional
03 - Multidirectional

Number of Flake Scars

01 - 1
02 - 2
03 - 3
04 - 4
05 - 5
06 - 6 or more

Mistakes

01 - Step 1,2
02 - Hinge 1,3
03 - Otrepasse
04 to 05 - Combinations of above

Crushing

01 - Present on 1
02 - Present on several

Metrics

01 - Length
02 - Width
03 - Thickness

Platform Metrics

01 - Length
02 - Width

Bulb

01 - Diffuse bulb
02 - Cone present
03 - Distinct bulb

Table 42 COMPUTER CODE

GROUND STONE - CODING

A. Whole/Partial

01 - Whole
02 - Partial

B. Shape

00 - Undetermined
01 - Rectangular
02 - Square
03 - Round
04 - Ovoid
05 - Triangular

C. Manufacture

01 - Pecking
02 - Grinding
03 - 01 + 02
04 - Scratching
05 - 01 + 04

D. Number of Used Areas

01 - 1
02 - 2
03 - 3
04 - 4
05 - 5
06 - 6

E. Wear

01 - Planar facet abraded
02 - Convex facet abraded
03 - Concave facet abraded
04 - Planar smooth
05 - Convex smooth
06 - Concave smooth
07 - Concave pitted
08 - Planar scratched
09 - Planar smooth polished
10 - Convex smooth polished
11 - Concave smooth polished
12 to 39 - Combinations of above

F. Type

00 - Undetermined
01 - Milling stones
02 - Handstone
03 - Mano
04 - Rasp
05 - Abrader
06 - Mortar
07 - Hammerstone
08 - Pitted stones
09 - Pestle
10 - Pottery anvil
11 - Palette
12 to 22 - Combinations of above

G. Surface Alteration

00 - None
01 - Varnish
02 - Groundstain
03 - Oxidation
04 - Black deposit
05 - Caliche
06 - Burned
07 - Water worn
08 to 16 - Combinations of above

H. Material

01 - Basalt
02 - Scoriaceous basalt
03 - Micaceous schist
04 - Rhyolite
05 - Rhyolite porphyry
06 - Andesite
07 - Sandstone
08 - Other
09 - Andesite porphyry

I. Metrics

Greatest length, width, thickness
00 - 0 to 0.5
01 - 0.5 to 1.0
02 - 1.0 to 1.5
03 - 1.5 to 2.0
etc

J. Use Areas

01 - 1
02 - 2
03 - 3
etc

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